BANGALORE WATER SUPPLY AND SEWERAGE BOARD

CAUVERY BHAVAN, KEMPEGOWDA ROAD,
BANGALORE – 560 009

TENDER FOR THE WORK OF

WORK OF REHABILITATION AND REPAIR WORKS TO 11ML CAPACITY RCC CIRCULAR GLR UNDER BANAGIRI SERVICE STATION OF AEE(SW-4) SUB DIVISION.-2ND CALL

Office of the Engineer–in-Chief
BANGALORE WATER SUPPLY & SEWERAGE BOARD
2nd floor, Cauvery Bhavan,
K G road, Bangalore 560009.
Telephone – 080 22945105
Telefax – 22945105

e-mail – eic@bwssb.gov.in
Website - www.bwssb.org

TENDER REFERENCE:	:	BWSSB/EIC/ACE(NRW)/3335/ 2025-26 / Dt: 25-09-2025
DATE OF PUBLICATION IN E-PORTAL	:	06-11-2025
LAST DATE FOR SUBMISSION OF TENDER IN E PORTAL	:	13-11-2025 up to 15:00 Hrs
TIME AND DATE OF OPENING OF TECHNICAL TENDER	:	14-11-2025 after 16:00 Hrs
PLACE OF OPENING OF TECHINCAL TENDER	:	Office of the Engineer-in-Chief, 2nd floor, Cauvery Bhavan, KG Road, Bangalore – 560 009
TIME AND DATE OF OPENING OF PRICE TENDERS	:	Will be intimated to the Qualified Tenderers
PLACE OF OPENING OF PRICE TENDER	:	Will be intimated to the Qualified Tenderers
ADDRESS FOR COMMUNICATION	:	Engineer-in-Chief 2nd floor, Cauvery Bhavan, KG Road, Bangalore – 560 009 Telephone – 080 22945105 Telefax – 22945105 e-mail – eic@bwssb.gov.in

Contractor
Employer

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SECTION 1:

BANGALORE WATER SUPPLY AND SEWERAGE BOARD

Office of the Engineer-in-Chief

2nd Floor, Cauvery Bhavan,K.G.Road, Bangalore 560009

Website www.bwssb.org email eic@bwssb.gov.in

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INVITATION FOR TENDER – SHORT TERM
(ONLY THROUGH E-PROCUREMENT PORTAL)

www.eproc.karnataka.gov.in)

IFT No.: BWSSB/EIC/ACE(CS& DCW)/TA/4129/2025-26 Dated: 04-11-2025

1. The ***Engineer-in-Chief*** invites tender from eligible tenderers, for the construction of work detailed in the Table below through e-PROCUREMENT process with two stages tender procedure in line with the Rule 28 of the KTPP Act. The details regarding their qualification to take the tender (as detailed in ITT Clause 4) and the price tender shall be uploaded in the website of the e-procurement wizard. Technical details will be opened on the date and time mentioned in IFT clause 5 and evaluated. The price tender of the Tenderer, who is found to be qualified to execute the tendered works, will be opened on the date notified later. The Tenderers are advised to note the minimum qualification criteria specified in Clause 3 of the Instructions to Tenderers(ITT) to qualify for award of the contract.

2. Tender documents may be downloaded through the e-procurement wizard which will link to www.eproc.karnataka.govt.in from **06.11.2025 to 13.11.2025**, on payment of a non-refundable fee indicated in the Table below, using any of these forms of OTC,NEFT, DEBIT CARD and CREDIT CARD through e-portal only**.** Interested tenderers may obtain further information at the Office of e-procurement. Tenderers will be issued a password and authorized for accessing the tender document in the website with URL: **www.eproc.karnataka.govt.in**

3. The Bidders can download the e-tender document using their user ID –password, by accessing **www.eproc.karnataka.govt.in** where electronic tender form is provided. Additional information related to e-tender process can be obtained through the above-mentioned website. The electronic tender will be operated as Two stage Tender system by opening the Technical details first and financial portion of the eligible tenderers later.

4. Tenders must furnish Earnest Money Deposit specified for the work in the Table below. Earnest Money Deposit will have to be paid through any one of the forms OTC,NEFT, DEBIT CARD and CREDIT CARD through e-portal only.

Sl. No	Name of Work	Cost of Tender Document including Taxes Rs.	Amount put to Tender Rs. in Lakh (Approx) (Excluding GST)	Bid Security Rs. in Lakh	Period of completion	Eligibility Criteria during last 5 years (2020-21, 2021-22, 2022-23, 2023-24 & 2024-25)	
						Turnover (in all classes of Civil Engineering construction works) for any of the two years Rs. in Lakhs	Performance & Work Qualification
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Work of Rehabilitation and Repair works to 11ML capacity RCC Circular GLR under Banagiri Service Station of AEE(SW-4) Sub Division-2nd call	To be specified by e-procurement cell.	**305.20**	**4.57**	18 months (Including monsoon period)	**720.28**	i) as prime contractor should have satisfactorily completed during the last five years at least one similar work to an extent of 50% of the cost of the work value not less than **Rs.180.07 lakhs** ii) Executed in any one year, the following minimum quantities of work: a. Removal of existing concrete wearing coat - **2103 Sqm** b. Epoxy bonding **-2103 Sqm** c. Providing and fixing of shear links - **2433**

							Nos d. Sealing of crack/porous concrete with epoxy-**4624 Kgs** e. Cement concrete-**285 Cum,** f. Cement plaster**-2103 Sqm** g. TMT Steel-**28.47 Tonne** h. Providing and laying water proofing treatment—**3374Sqm** Tenderer should have past experience in GLR/ Rehabilitation work

5. The last date for uploading of completed tender document is on **13-10-2025** up to **1500 hrs.**

6. The bids will be opened at the office mentioned in para no.12 on **14-10-2025** at **16:00 hrs** in the presence of bidders or their authorized representatives. If the bid opening day remains as public holiday, Bids will be opened on the next working day at the original stipulated time.

7. Bidders can access tender documents from the website and upload the required details; those are mentioned in different sections in the bid document in to electronic tender box on the website. Scanned documents those are required to be furnished as per Section 2, 3 & 4 of the bid document shall be submitted through e-portal preferably in **PDF** format for clear vision.

8. The cost of the tender document once paid will not be refunded.

9. The successful bidder would be required to give performance **bank guarantee of 5%** of the contract amount plus additional security for unbalanced bid amount from a Nationalized / Scheduled Indian Bank, with jurisdiction at Bangalore as specified in the clause no.29 of ITT, towards guarantee for completion of work within the stipulated period.

10. Applications / requisitions from joint venture Firms are not acceptable.

11. Bangalore Water Supply and Sewerage Board reserve the right to cancel or annul the entire or part of this process of invitation at any time without assigning any reason.

12. For any additional information regarding the above tender, the firms who are interested to quote, may contact office of the undersigned at the office address given below on all working days during office hours 1030hours to 1700 hours.

Engineer-in-Chief
Bangalore Water Supply and Sewerage Board
2rd Floor, Cauvery Bhavan, Kempe Gowda Road, Bangalore - 560009
Karnataka, India.
Tel Fax: -91-80-22945105
Telephone: +91-80- 22945105
Or **visit Website www.bwssb.org**

Email eic@bwssb.gov.in

1. List of documents to support qualification of bidder is to be uploaded to the e-procurement website www.eproc.karnataka.gov.in
2. Bidders shall submit offers that comply with the requirements of the bid document, **including the basic technical design as indicated in the drawing and specifications**. Alternatives will not be considered. The attention of the bidders is drawn to clause 23 regarding the rejection of the bids, which are not substantially responsive to the requirement of the bid document.
3. Other details can be read from the tender documents.
4. Corrigendum/Addendum/Modification/corrections, if any, will be published in the Web site only.

Sd/-
Engineer-in-Chief
Bangalore Water supply & Sewerage Board

SECTION 2:

INSTRUCTIONS TO TENDERERS (ITT)

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A. General

1. Scope of Tender

1.1 The ***Engineer-in-Chief, BWSSB,*** (Referred to as Employer in these documents) invites tenders following Two Cover e-procurement procedure, from eligible Tenderers, for the construction of work (as defined in these documents and referred to as "the work") detailed in the Table given in the Invitation for Tenders (IFT).

2. Eligible Tenderers

2.1 Tenderers shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by the Government of Karnataka

2.2 Tenders from Joint ventures are not acceptable.

3. Qualification of the Tenderer:

1 3.1 All Tenderers shall provide the requested information accurately and in sufficient detail in Section 3: Qualification information.

3.2 **To qualify for award of this contract, each Tenderer in its name should have in the last five years i.e. 2020-21 to 2024-25)**

a) Should have achieved in at least two financial years a minimum financial turnover (in all classes of civil engineering construction works) of **Rs. 720.28 Lakhs (Including GST)**

b) The Tenderer as prime contractor should have satisfactorily completed during the last five years at least one similar work to an extent of 50% of the cost of the work value not less than **Rs.180.07 lakhs(Including GST)**

executed in any one year, the following minimum quantities of work:

a) Removal of existing concrete wearing coat -**2103 Sqm**
b) Epoxy bonding **-2103 Sqm**
c) Providing and fixing of shear links - **2433 Nos**
d) Sealing of crack/porous concrete with epoxy-**4624 Kgs**
e) Cement concrete- **285 Cum,** Cement plaster**-2103 Sqm**
f) TMT Steel-**28.47 Tonne**
g) Providing and laying water proofing treatment—**3374Sqm**

Tenderer should have past experience in GLR /Rehabilitation work

Note: @ Updated to the FY in which the tenders are invited. Financial turn over of previous years shall be given a weight of 10% per year to bring them to the price level of the FY in which the tenders are invited

0 3.3 Each Tenderer should further demonstrate:
0 (a) Availability by owning 50% of the required / specified key and critical
0 equipment for this work and remaining 50% can be deployed on lease / hire
0
1 basis for all works provided, the relevant documents (commitment
1 agreements etc.,) for availability for this work shall be furnished. Some of the
2 equipment are:
3

(i)	Concrete mixers	-	5 no.
(ii)	Pin vibrators	-	5 no.
(iii)	Plate vibrators	-	5 no.
(iv)	De watering pumps	-	5 No
(v)	Excavators	-	2 No
(vi)	Compressors	-	1 no
(vii)	Tractors	-	2 no

b. Liquid assets and /or availability of credit facilities of no less than **Rs 60.02 lakhs.-**(Credit lines/letter of credit/certificates from Nationalized / Schedule banks in India for meeting the fund requirement etc.,

3.4 To qualify for a package of contracts made up of this and other contracts for which tenders are invited in this IFT, the Tenderer must demonstrate having experience and resources to meet the aggregate of the qualifying criteria for the individual contracts.

3.5 Sub-contractors' experience and resources shall not be taken into account in determining the Tenderer's compliance with the qualifying criteria except to the extent stated in 3.2 (d) and (e) above.

1 3.6 Tenderers who meet the above specified minimum qualifying criteria, will only be qualified, if their available tender capacity is more than the tender value (**Rs.360.14 Lakhs (Including GST)** The available tender capacity will be calculated as under:

Assessed available tender capacity = (A*N*1.5 - B)

where

A = Maximum value of civil engineering works executed in any one year during the last five years (updated to **2024-25** price level) taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the works for which tenders are invited.

B = Value, at **2024-25** price level, of existing commitments and on-going works to be completed during the next **1** years (period of completion of the works for which Tenders are invited)*

Note: The statements showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each of the works listed should be countersigned by the Employer in charge, not below the rank of an Executive Engineer or equivalent.

3.7 Even though the Tenderers meet the above criteria, they are subject to be disqualified if they have:

- made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements; and/or
- record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.; and/or
- participated in the previous Tender for the same work and had quoted unreasonably high tender prices and could not furnish rational justification.

4. One Tender per Tenderer:

4.1 Each tenderer shall submit only one tender for one package. A tenderer who submits or participates in more than one Tender (other than as a sub-contractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Tenderer's participation to be disqualified.

5. Cost of Tendering:

5.1 The tenderer shall bear all costs associated with the preparation and submission of his tender, and the Employer will in no case be responsible and liable for those costs.

6. Site visit:

6.1 The Tenderer at his own responsibility and risk is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Tender and entering into a contract for construction of the Works. The cost of visiting the Site shall be at the Tenderer's own expense.

B. Tender documents

7. Content of Tender documents

7.1 The set of tender documents shall have all the Sections given in Page 2:

7.2 Both the sets should be completed and returned with the tender.

8. Clarification of Tender Documents

8.1 A prospective tenderer requiring any clarification of the tender documents may notify the Employer in writing or by cable

(hereinafter "cable" includes telex, facsimile and e-mail) at the Employer's address indicated in the invitation to tender. The Employer will respond to any request for clarification which he receives earlier than 15 days prior to the deadline for submission of tenders. Copies of the Employer's response will be forwarded to all purchasers of the tender documents through e-mail, including a description of the enquiry but without identifying its source. Same will available in the website of e-procurement www.eproc.karnataka.gov.in.

8.2 Pre-tender meeting:

8.2.1 **Deleted.**

8.2.2 **Deleted.**

8.2.3 **Deleted.**

8.2.4 **Deleted.**

8.2.5 **Deleted.**

9. Amendment of Tender documents

9.1 Before the deadline for submission of tenders, the Employer may modify the tender documents by issuing addenda.

9.2 Any addendum thus issued shall be part of the tender documents and shall be communicated in writing or by cable to all the purchasers of the tender documents.

9.3 To give prospective Tenderers reasonable time in which to take an addendum into account in preparing their tenders, the Employer shall extend as necessary the deadline for submission of tenders, in accordance with Sub-Clause 16.2 below.

C. Preparation of Tenders

10. Documents comprising the Tender

10.1 The tender submitted in e-procurement portal by the Tenderer shall contain the documents as follows:

(a) Scanned copy of Earnest Money Deposit made ;
(b) Scanned copies of Qualification Information as per formats given in Section 3;
(c) The Tender (in the format indicated in Section 4)
(d) Priced Bill of Quantities (Section 9);

and any other materials required to be completed and submitted by Tenderers in accordance with these instructions. The documents listed under Sections 3, 4, 6 and 9 shall be filled in without exception. The Earnest Money Deposit shall be submitted to the Tender inviting authority on or before the time of submission mentioned in IFT. PHOTOCOPIES OF THE DOCUMENTS SHOULD BE NOTARISED.

10.2 Tenderers submitting tenders together with other contracts stated in the IFT to form a package will so indicate in the tender

together with any discounts offered for the award of more than one contract.

11. Tender prices

11.1 The contract shall be for the whole works as described in Sub-Clause 1.1, based on the priced Bill of Quantities submitted by the Tenderer.

11.2 The bidder shall fill in the unit rates in figures for all items of the Works described in the Bill of Quantities. The system will automatically convert the unit rates mentioned in figures to words and also calculate the amount of that item as well as the total Bid value. *Items for which no rate is entered by the bidder will not be paid for by the Employer when executed and shall be deemed covered by the other rates in the Bill of Quantities*

11.3 All duties, taxes, and other levies payable by the contractor under the contract, or for any other cause, shall be included in the rates, prices and total Tender Price submitted by the Tenderer.

11.4 Deleted

12. Tender validity

12.1 Tenders shall remain valid for a period not less than **ninety days** after the deadline date for tender submission specified in Clause 16. A tender valid for a shorter period shall be rejected by the Employer as non-responsive.

12.2 In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the Tenderers may extend the period of validity for a specified additional period. The request and the Tenderers' responses shall be made in writing or by cable or e-mail. A Tenderer may refuse the request without forfeiting his earnest money deposit. A Tenderer agreeing to the request will not be required or permitted to modify his tender, but will be required to extend the validity of his earnest money deposit for a period of the extension, and in compliance with Clause 13 in all respects.

13. Earnest money deposit

13.1 The Tenderer shall furnish, as part of his tender, earnest money deposit in the amount as shown in column 2 of the Table of IFT for this particular work. This earnest money deposit shall be in favour of ***Chairman, BWSSB*** and may be in the form of Banker's cheque/ Demand draft/Pay Order, in favour of ***Chairman, BWSSB*** payable at ***BANGALORE*** from any Nationalized / Scheduled Indian banks.

13.2 Instruments having fixed validity issued as earnest money deposit for the tender shall be valid for 45 days beyond the validity of the tender.

13.3 Any tender not accompanied by an acceptable earnest money deposit and not secured as indicated in Sub-Clauses 13.1 and 13.2 above shall be rejected by the Employer as non-responsive.

13.4 The earnest money deposit of unsuccessful Tenderers will be returned within 30 days of the end of the tender validity period specified in Sub-Clause 12.1.

13.5 The earnest money deposit of the successful Tenderer will be discharged when the Tenderer has signed the Agreement and furnished the required Performance Security.

13.6 The earnest money deposit may be forfeited:

(a) if the Tenderer withdraws the Tender after tender opening during the period of tender validity;
(b) if the Tenderer does not accept the correction of the Tender Price, pursuant to Clause 24; or
(c) in the case of a successful Tenderer, if the Tenderer fails within the specified time limit to
(i) sign the Agreement; or
(ii) furnish the required Security deposit

14. Format and signing of Tender

14.1 The completed bid comprising of documents indicated in ITB 12, should be uploaded in the **e procurement portal of BWSSB** through the website **www.eproc.karnataka.gov.in** along with scanned copies of requisite certificates those are mentioned in different sections in the bid document and scanned copy of Bid Security / EMD in case it is provided in the form of Banker's cheque/ Demand draft/Pay Order

14.2 All the documents should be uploaded to the **e procurement portal of BWSSB**. Tenderer should take a print out of the declaration letter provided in the website on company letter head and should sign, stamp and upload the same to the tender wizard of BWSSB.

14.3 Deleted

D. Submission of Tenders

15. Up-loading & submission of tenders

15.1 The tenders should be uploaded only through **e-procurement portal**. Tender should contain

A. Technical Tender consisting of following:

a. All the documents with required details in prescribed format; those are mentioned in different sections in the Tender. Form of Tender, Declaration statement regarding Customs/ Excise duty exemption for materials/ construction equipment brought to site as mentioned in Section 2, etc., shall be downloaded, filled with required details, signed, scanned & uploaded to the e-procurement

portal website **www.eproc.karnataka.gov.in/BWSSB** on or before the time and date indicated in notification /Section I IFT.

b. **Tender security.** Tender security can be paid to BWSSB in the form of Banker's cheque/ Demand draft/Pay Order (the details like reference number, date, name of the Bank and drawn in favour are to be registered on the tender wizard of BWSSB)

The above documents along with notarized copies of documentary evidences as indicated in Section—II ITT, Section-III Qualification information & Section IV Forms of Tender shall be scanned and uploaded to the website compulsorily, failing which tender will be rejected in view of incomplete bid document and

B. Financial Tender consisting of Bill of Quantities (file name: BOQ.xls). The tenderer shall down load the bill of quantities and key in the rates (in figures only) in the Bill of Quantities sheet and upload the same file on to the website on or before the time and date indicated in notification /Section I IFT.

Scanned copy of Bid security (as cited in IFT Para No.2) provided in the form of Banker's cheque/ Demand draft/Pay Order, is to be uploaded to the e procurement portal of BWSSB before **15:00 hrs on, Dt : 12.10.2025.** In case of failure of the tenderer to submit the same within stipulated time, their tender will be rejected.

NOTE:

1. URL of the Website for tender submission through e-procurement portal is as follows:

i www.eproc.karnataka.gov.in**.**

ii **Engineer-in-Chief**
Bangalore Water Supply and Sewerage Board,
2nd Floor, Cauvery Bavan,
K.G.Road, Bangalore560009
Karnataka, India.
Tel Fax; +91-80-22945105, Telephone: +91-80- 22945105

2. The details related to submission of tenders, downloading / uploading of documents or other details are available online in the help wizard, Vendor manual & FAQ of above website. The same is provided along with sample formats in Annexure-I of the Bid document for ready reference.

15.2 Deleted

15.3 Unique Identification Number will be automatically generated by the server with time - stamp and sent to the account of the bidder as an acknowledgement after bidder finally uploads the bids.

15.4 Deleted

16. Deadline for submission of the Tenders

16.1 Tenders must upload all the tender documents in the e-procurement portal no later than **13.10.2025 Upto 15.00 Hrs**. In the event of the specified date for the submission of tenders being changed / postponed by the Employer due to unforeseen circumstances, the corrigendum will be issued in the news paper & the deadline for submission of tenders will be intimated accordingly.

16.2 The Employer may extend the deadline for submission of tenders by issuing an amendment/corrigendum in accordance with Clause 9, in which case all rights and obligations of the Employer and the Tenderers previously subject to the original deadline will then be subject to the new deadline.

17. Late Tenders

17.1 The software of e-procurement system will not allow the Bidder to upload the documents after expiration of the stipulated date & time of Bid submission. The Bidder shall refer the server time, which will be displayed in the e-procurement portal of BWSSB. Employer will not be responsible for non-receipt of bids on the stipulated date & time prescribed in clause 16, due to Internet Problems, improper uploading or any other related problems. In case of connectivity problems, Tenderer may contact Helpdesk of the e-tender service provider and may also draw the attention of tender inviting authority.

18. Modification and Withdrawal of Tenders

18.1 Tenderers may “modify” and “withdraw” their tenders multiple numbers of times, until the deadline for submission of tenders by operating the relevant provision made in e-tendering. If the Tenderer withdraws the tender before the deadline for submission of tenders and later if he is interested to submit the tender once again, may do so within the stipulated date & time as mentioned in Clause 16. In this case within the stipulated date & time, the tenderer can once again submit the requisition to the officer inviting tenders for access to the withdrawn tender document for resubmission. For this tenderer need not make any additional payment towards the cost of tender document. Communication of modification / withdrawal by other means will not be accepted.

18.2 Deleted.

18.3 No Tender may be modified after the deadline for submission of Tenders.

18.4 Withdrawal or modification of a Tender between the deadline for submission of Tenders and the expiration of the original period of Tender validity specified in Clause 12.1 above or as extended pursuant to Clause 12.2 may result in the forfeiture of the earnest money deposit pursuant to Clause 13.

18.5 Tenderers may offer discounts for individual items by simply modifying the quoted unit price in the Bill of Quantities. Also, Tenderer may enter their overall discount, at specified location in the Bill of Quantities only, by submitting tender modifications in accordance with this clause. Communication of discount by other means will not be accepted.

E. Tender opening and evaluation

19. Opening of Technical portion of Tenders and evaluation to determine qualified Tenderers:

19.1 The Employer will open the Technical details of all the Tenders received (except those withdrawn), including modifications made pursuant to Clause 18, in the presence of the Tenderers or their representatives on **14.10.2025** after **16:00 hrs**. In the event of the specified date of Tender opening being declared a holiday for the Employer, the Tenders will be opened at the appointed time and location on the next working day.

19.2 WITHDRAWAL proposal submitted pursuant to clause 18 shall be read out first and their bids shall not be opened.

19.3 The Tenderers names, the presence or absence of earnest money deposit (amount, format and validity), the submission of qualification information and such other information as the Employer may consider appropriate will be announced by the Employer at the opening.

19.4 The Employer shall prepare minutes of the Tender opening, including the information disclosed to those present in accordance with Sub-Clause 19.3.

19.5 The Price Tenders of all the Tenderers including modifications for Financial tenders can not be opened as this is programmed to open later after evaluation of the Technical details of the participating Tenderers.

19.6 The Employer will evaluate and determine whether each tender (a) meets the eligibility criteria defined in ITT Clause 2; (b) is accompanied by the required earnest money deposit as per stipulations in ITT Clause and (c) meets the minimum qualification criteria stipulated in ITT Clause 3. The Employer will draw out a list of qualified Tenderers.

20. Opening of Price Tender of qualified Tenderers and evaluation:

20.1 The Employer will inform all the Qualified Tenderers the time, date and venue fixed for the opening of the price Tenders. The Employer will open the price tender of Qualified Tenderers at the appointed time and date in the presence of the Tenders or their representatives who choose to attend. In the event of the specified date of Price tender opening being declared a holiday

for the Employer, the price tenders will be opened at the appointed time and location on the next working day.

20.2 Deleted.

20.3 The Tenderers' names, the Tender prices, the total amount of each Tender, any discounts, and withdrawals, and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening. No Tender shall be rejected at Tender opening.

20.4 The Employer shall prepare minutes of the Price Tender opening, including the information disclosed to those present in accordance with Sub-Clause 20.3.

21. Process to be confidential

21.1 Information relating to the examination, clarification, evaluation, and comparison of Tenders and recommendations for the award of a contract shall not be disclosed to Tenderers or any other persons not officially concerned with such process until the award to the successful Tenderer has been announced. Any effort by a Tenderer to influence the Employer's processing of Tenders or award decisions may result in the rejection of his Tender.

22 Clarifications of Tenders

22.1 To assist in the examination, evaluation, and comparison of Tenders, the Employer may, at his discretion, ask any Tenderer for clarification of his Tender, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by cable, but no change in the price or substance of the Tender shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Tenders in accordance with Clause 24.

22.2 Subject to sub-clause 22.1, no Tenderer shall contact the Employer on any matter relating to its Tender from the time of the Tender opening to the time the contract is awarded. If the Tenderer wishes to bring additional information to the notice of the Employer, it should do so in writing.

22.3 Any effort by the Tenderer to influence the Employer in the Employer’s Tender evaluation, Tender comparison or contract award decisions may result in the rejection of the Tenderers’ Tender.

23. Examination of Tenders and determination of responsiveness

23.1 Prior to the detailed evaluation of Tenders, the Employer will determine whether each Tender; (a) has been properly signed; and;

(b) is substantially responsive to the requirements of the Tender documents like [(a)Form of Tender, (b)Declaration statement regarding Customs/ Excise duty exemption for materials/ construction equipment brought to site as mentioned in Section 2 etc.,] Scanned / uploaded [including documents those are required to be furnished as per Section 2, 3 & 4 of the tender,]; (c) is accompanied by the required securities and; (d) is substantially responsive to the requirements of the tendering documents.

23.2 A substantially responsive Tender is one which conforms to all the terms, conditions, and specifications of the Tender documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the Tender documents, the Employer's rights or the Tenderer's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Tenderers presenting substantially responsive Tenders.

23.3 If a Tender is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

24. Correction of errors

24.1 (a) Once the Tenderer key in the rates in figures, in the Bill of quantities provided, rate in words will be auto generated by the system.

(b) Once the Tenderer key in the rates in figures, in the Bill of quantities provided, the system will automatically calculate the amount of that item as well as the total Bid value.

24.2 Deleted

25. Evaluation and comparison of Tenders

25.1 The Employer will evaluate and compare only the Tenders determined to be substantially responsive in accordance with Clause 23.

25.2 In evaluating the Tenders, the Employer will determine for each Tender the evaluated Tender Price by adjusting the Tender Price as follows:

(a) making any correction for errors pursuant to Clause 24; and

(b) making appropriate adjustments to reflect discounts or other price modifications offered in accordance with Sub Clause 18.5.

25.3 The Employer reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors which are in excess of the requirements of the Tender documents or otherwise result

in unsolicited benefits for the Employer shall not be taken into account in Tender evaluation.

25.4 The estimated effect of the price adjustment conditions under Clause 41 of the Conditions of Contract, during the implementation of the Contract, will not be taken into account in tender Evaluation

25.5 If the tender of the successful tenderer is seriously unbalanced in relation to the Employer's estimate of the cost of the work to be performed under the contract, the Employer may require the Tenderer to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the performance security set forth in Clause 29 be increased at the expense of the successful Tenderer to a level sufficient to protect the Employer against financial loss in the event of default of the successful under the contract.

F. Award of Contract

26. Award criteria

26.1 Subject to Clause 27, the Employer will award the Contract to the Tenderer whose Tender has been determined to be substantially responsive to the Tender documents and who has offered the lowest evaluated Tender Price, provided that such Tenderer has been determined to be (a) eligible in accordance with the provisions of Clause 2, and (b) qualified in accordance with the provisions of Clause 3.

27. Employer's right to accept any Tender and to reject any or all Tenders

27.1 Notwithstanding Clause 26, the Employer reserves the right to accept or reject any Tender, and to cancel the Tender process and reject all Tenders, at any time prior to the award of Contract, without thereby incurring any liability to the affected Tenderer or Tenderers or any obligation to inform the affected Tenderer or Tenderers of the grounds for the Employer's action.

28. Notification of award and signing of Agreement

28.1 The Tenderer whose Tender has been accepted will be notified of the award by the Employer prior to expiration of the Tender validity period by cable, telex, e-mail or facsimile confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the

Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").

28.2 The notification of award will constitute the formation of the Contract, subject only to the furnishing of Security deposit in accordance with the provisions of Clause 29.

28.3 The Agreement will incorporate all agreements between the Employer and the successful Tenderer. It will be kept ready for signature of the successful Tenderer in the office of Employer within 30 days following the notification of award along with the Letter of Acceptance. Within 20 days of receipt, the successful Tenderer will sign the Agreement and deliver it to the Employer.

28.4 Upon the furnishing by the successful Tenderer of the Performance Security, the Employer will promptly notify the other Tenderers that their Tenders have been unsuccessful.

29. Security deposit

29.1 Within 20 days of receipt of the Letter of Acceptance, the successful Tenderer shall deliver to the Employer a Security deposit in any of the forms given below for an amount equivalent to 5% of the Contract price plus additional security for unbalanced tenders in accordance with Clause 25.5 of ITT and Clause 44 of the Conditions of Contract. :

1 - Cash or

2 - Banker’s cheque/Demand draft,/Pay Order in favour of ***Chairman, BWSSB*** payable at ***Bangalore*** or

3 - A bank guarantee in the form given in Section 10; or

29.2 If the security deposit is provided by the successful Tenderer in the form of a Bank Guarantee, it shall be issued either by a Nationalized/Scheduled bank.

29.3 The security deposit if furnished in cash or demand draft can, if requested, be converted to interest bearing securities at the cost of the contractor.

29.4 Failure of the successful Tenderer to comply with the requirements of Sub-Clause 29.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Earnest money deposit.

30 Advance Payment and Security:

30.1 The Employer will provide an advance payment on the contract price as stipulated in the Conditions of Contract, subject to the maximum amount as stated in the Contract Data.

31. Corrupt or Fraudulent practices

31.1 The GOK requires that the Tenderers/Suppliers/Contractors, observe the highest standard of ethics during the procurement

and execution of such contracts. In pursuance of this policy, GOK :

(a) will reject a proposal for award if it determines that the Tenderer recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;

(b) will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a GOK contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a GOK contract.

31.2 Furthermore, Tenderers shall be aware of the provision stated in sub-clause 50.2 of the Conditions of Contract.

SECTION 3:

QUALIFICATION INFORMATION

The following form is to be downloaded, particulars are to be filled, scanned & uploaded by the Bidder, to the tender wizard of BWSSB **"**www.eproc.karnataka.gov.in**"** along with the Bid.

Note: The detailed procedure for downloading / uploading the documents will be available in Help wizard, Vendor manual & FAQ of the above mentioned Website.

The information to be filled in by the Tenderer hereunder will be used for purposes of computing Tender capacity as provided for in Clause 3 of the Instructions to Tenderers. This information will not be incorporated in the Contract.

1.1 Constitution or legal status of Tenderer [Attach copy]

Place of Registration _____
(Attach Copy)

Principal place of business: _____

1.2 Total value of civil engineering construction works executed and payments received in the last five years (in Rs. Lakhs)

2020 – 21 _____

2021 – 22 _____

2022 – 23 _____

2023 – 24 _____

2024 - 25 _____

1.3 Work performed as Prime Contractor (in the same name) on works of similar nature over during the five years specified in 1.2 above.

Project Name	Name of Employer	Description of Work	Contract Number	Value of contract Rs. Lakhs	Date of issue of work order	Specified period of completion	Actual date of completion	Remarks explaining reasons for delay in completion of work
1	2	3	4	5	6	7	8	9

1.4 Quantities of work executed as prime contractor (in the same name) during the last five years specified in 1.2 above:

Year	Name of Work	Name of Employer	Quantity of work performed (cum)[1]	Remarks (Indicate contract reference)

[1] Items of work for which data is requested should tally with that specified in ITT Clause 3

			Cement Concrete	Masonry	Earthworks	
2020-21						
2021-22						
2022-23						
2023-24						
2024-25						

1.5 Information on works for which Tenders have been submitted and works which are yet to be completed as on the date of this Tender.

(A) Existing commitments and on-going works:

Description of Work	Place & State	Contract No. & Date	Name and Address of Employer	Value of Contract (Rs. lakhs)	Stipulated period of completion	Value of works[2] remaining to be completed (Rs. lakhs)	Anticipated date of completion
1	2	3	4	5	6	7	8

(B) Works for which Tenders already submitted:

Description of Work	Place & State	Name and Address of Employer	Estimated value of works (Rs. lakhs)	Stipulated Date period of completion	when decision is expected	Remarks if any
1	2	3	4	5	6	7

1.6. The following items of equipment are considered essential for successfully carrying out the works. The Tenderer should furnish all the information listed below.

Item of Equipment	Requirement[3]			Owned and available		Remarks
	No.	Capacity	Owned	Number/ Capacity	Age/ Condition	

1.7 Reports on the financial standing of the tenderer, such as profit and loss statements and auditor's reports for the last five years;

[2] Contractor shall enclose / attach / up load all necessary certificates duly attested by the employer

[3] The Item of equipment, required number and capacity should match with those in ITT Clause 3.3(a) (Filled scanned & uploaded)

1.8 Qualification and experience of the key technical and management personnel in permanent employment with the tenderer and those that are proposed to be deployed on this contract, if awarded.

1.9. Name, address, and telephone, telex, and fax numbers of the Tenderers' bankers who may provide references if contacted by the Employer.

1.10 Evidence of access to financial resources to meet the qualification requirement specified in ITT Clause3.3 (b): Cash in hand, Letter of Credit etc. List them below and attach certificate from the Banker in the suggested format as under:

BANKER'S CERTIFICATE

This is to certify that M/s. …… is a reputed company with a good financial standing. If the contract for this work, namely …… (name of the work) is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of Rs. …… to meet the working capital requirements for executing the above contract.

Sd/-
Name of the Bank, Senior Bank Manger
Address:
……

1.11 Proposals for subcontracting components of works amounting to more than 20% of the contract price .

Item of Work	Value of Sub-Contract	Identified Sub-Contractor (Name and address)	Experience of similar work [4]

1.12 Information on litigations in which the Tenderer is involved:

Other Party (ies)	Employer	Details of dispute	Amount involved	Remarks showing present status

1.13 The proposed methodology and program of construction, backed with equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of execution and completion of the work as per technical specifications within the stipulated period of completion as per milestones.

[4] Attach Certificate from the respective Employers (scanned & Uploaded)

SECTION 4:

FORMS OF TENDER, LETTER OF ACEPTANCE, NOTICE TO PROCEED WITH THE WORK AND AGREEMENT FORM

Form of Tender

Description of the Works: **Tender for the Work of Rehabilitation and Repair works to 11ML capacity RCC Circular GLR under Banagiri Service Station of AEE(SW-4) Sub Division.**

Tender

To
Engineer-in-Chief,
Bangalore Water Supply and Sewerage Board,
2nd Floor, Cauvery Bavan,
K.G.Road, Bangalore560009

GENTLEMEN,

We offer to execute the Works described above in accordance with the Conditions of Contract accompanying this Tender.

This Tender and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Tender you receive.

The advance payment required is Rs.....

We undertake that, in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely "Prevention of Corruption Act 1988".

We hereby confirm that this Tender complies with the Tender validity and Earnest money deposit required by the Tender documents.

We attach herewith our current income-tax clearance certificate.

Yours faithfully,

Authorized Signature:

Name & Title of Signatory: _____

Name of Tenderer _____

Address: ----------

Letter of Acceptance

(letterhead paper of the Employer)
_____[date]

To:

_____
[name and address of the Contractor]

Dear Sirs,

This is to notify you that your Tender dated _____ for execution of the _____ _____ [name of the contract and identification number, as given in the Instructions to Tenderers] for the Contract Price of Rupees —— _____ (_____) [amount in words and figures], as corrected and modified in accordance with the Instructions to Tenderers is hereby accepted by our Agency.

You are hereby requested to furnish Security deposit plus additional security for unbalanced tenders in terms of Clause 25.5 of ITT, in the form detailed in Clause 29.1 of ITT for an amount of Rs.——————— within 20 days of the receipt of this letter of acceptance valid up to 30 days from the date of expiry of Defects Liability Period i.e. up to ..... and sign the contract, failing which action as stated in Para 29.4 of ITT will be taken.

Yours faithfully,

Authorized Signature
Name and Title of Signatory
Name of Agency

Issue of Notice to proceed with the work

(letterhead of the Employer)
——————— (date)
To
——————————————————— (name and address of the Contractor)
———————————————
———————————————

Dear Sirs:

Pursuant to your furnishing the requisite security deposit as stipulated in ITT Clause 29.1 and signing of the contract agreement for the construction of ———————[name of the contract] a Tender Price of Rs.———————, you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents.

Yours faithfully,

(Signature, name and title of signatory authorized to sign on behalf of Employer)

Agreement Form

Agreement

This agreement, made the _____day of _____20_____, between_____ _____[name and address of Employer] (hereinafter called "the Employer") of the one part and _____ _____ _____ __ _____[name and address of contractor] (hereinafter called "the Contractor") of the other part.

Whereas the Employer is desirous that the Contractor execute _____ _____ _____ _____[name and identification number of Contract] (hereinafter called "the Works") and the Employer has accepted the Tender by the Contractor for the execution and completion of such Works and the remedying of any defects therein at a contract price of Rupees.....

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expression shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
4. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz:
   i) Letter of Acceptance;
   ii) Notice to proceed with the works;
   iii) Contractor's Tender;
   iv) Contract Data;
   v) Conditions of contract (including Special Conditions of Contract);
   vi) Specifications;
   vii) Drawings;
   viii) Bill of Quantities; and
   ix) Any other document listed in the Contract Data as forming part of the contract.

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of _____
was hereunto affixed in the presence of:
Signed, Sealed and Delivered by the said
_____
_____

in the presence of:
Binding Signature of Employer
_____

Contractor
Employer

Binding Signature of Contractor _____

SECTION 5:

CONDITIONS OF CONTRACT

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Conditions of Contract

A. General

1. Definitions

1.1 Terms which are defined in the Contract Data are not also defined in the Conditions of Contract but keep their defined meanings. Bold letters are used to identify defined terms.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Tender.

Compensation events are those defined in Clause 38 hereunder.

The **Completion Date** is the date of completion of the Works as certified by the Employer in accordance with Sub Clause 46.1.

The **Contract** is the contract between the Employer and the Contractor to execute, complete and maintain the Works. It consists of the documents listed in Clause 2.2 below.

The **Contract Data** defines the documents and other information which comprise the Contract.

The **Contractor** is a person or corporate body whose Tender to carry out the Works has been accepted by the Employer.

The **Contractor's Tender** is the completed Tender document submitted by the Contractor to the Employer.

The **Contract price** is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

Days are calendar days; months are calendar months.

A **Defect** is any part of the Works not completed in accordance with the Contract.

The **Defects liability period** is the period named in the Contract Data and calculated from the Completion Date.

The **Employer** is the party who will employ the Contractor to carry out the Works.

Equipment is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

The **Initial Contract price** is the Contract Price listed in the Employer's Letter of Acceptance.

The **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the Contract Data. The Intended Completion Date may be revised only by the Employer by issuing an extension of time.

Materials are all supplies, including consumables, used by the contractor for incorporation in the Works.

Plant is any integral part of the Works which is to have a mechanical, electrical, electronic or chemical or biological function.

The **Site** is the area defined as such in the Contract Data.

Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Employer.

The **Start Date** is given in the Contract Data. It is the date when the Contractor shall commence execution of the works. It does not necessarily coincide with any of the Site Possession Dates.

A **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract which includes work on the Site.

A **Variation** is an instruction given by the Employer which varies the Works.

The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Contract Data.

2. Interpretation

2.1 In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Employer will provide instructions clarifying queries about the Conditions of Contract.

2.2 The documents forming the Contract shall be interpreted in the following order of priority:

(1) Agreement
(2) Letter of Acceptance, notice to proceed with the works
(3) Contractor’s Tender
(4) Contract Data
(5) Conditions of Contract
(6) Specifications
(7) Drawings
(8) Bill of quantities and
(9) any other document listed in the Contract Data as forming part of the Contract.

3. Law governing contract

3.1 The law governing the Contract is the Laws of India supplanted by the Karnataka Local Acts.

4. Employer's decisions

4.1 Except where otherwise specifically stated, the Employer will decide contractual matters between the Employer and the Contractor .

5. Delegation

5.1 The Employer may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the Contractor.

6. Communications

6.1 Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

7. Subcontracting

7.1 Deleted

8. Other Contractors

8.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer.

9. Personnel

9.1 The Contractor shall employ the technical personnel (of number and qualifications) as may be stipulated by GOK from time to time during the execution of the work. The technical staff so employed shall be available at site as may be stipulated by the Employer.

9.2 If the Employer asks the Contractor to remove a person who is a member of the Contractor's staff or his work force stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.

10. Employer's and Contractor's risks

10.1 The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Employer's risks

11.1 The Employer is responsible for the excepted risks which are:

(a) rebellion, riot commotion or disorder unless solely restricted to employees of the Contractor or his Sub-Contractors arising from the conduct of the Works; or

(b) a cause due solely to the design of the Works, other than the Contractor's design; or

(c) any operation of the forces of nature (in so far as it occurs on the Site) which an experienced contractor:

(i) could not have reasonably foreseen; or

(ii) could reasonably have foreseen, but against which he could not reasonably have taken at least one of the following measures;
(A) prevent loss or damage to physical property from occurring by taking appropriate measures or
(B) insure against such loss or damage

12. Contractor's risks

12.1 All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the excepted risks are the responsibility of the Contractor.

13. Insurance:

13.1 The Contractor shall prior to commencing the works, effect and thereafter maintain insurances , in the joint names of the Employer and the Contractor, (cover from the first working day after the Start Date to the end of Defects Liability Period), in the amounts stated in the Contract Data :
(a) for loss of or damage to the Works, Plants and Materials and the Contractor's equipment;
(b) for liability of both Parties for loss, damage, death and injury to third parties or their property arising out of the Contractor's performance of the Contract including the Contractor's liability for damage to the Employer's property other than the Works and
(c) for liability of both Parties and of any Employer's representative for death and injury to the Contractor's personnel except to the extent that liability arises from the negligence of the Employer, any Employer's representative or their Employees.

13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Employer for his approval before the Start Date. All such insurance shall provide for compensation to be payable to rectify the loss or damage incurred. All payments received from insurers relating to loss or damage shall be held jointly by the Parties and used for the repair of the loss or damage or as compensation for loss or damage that is not to be repaired.

13.3 If the Contractor fails to effect or keep in force any of the insurances referred to in the previous sub-clauses or fails to provide satisfactory evidence, policies or receipts, the Employer may without prejudice to any other right or remedy, effect insurance for the cover relevant to such default and pay the premiums due and recover the same as a deduction from any other monies due to the Contractor. If no payment is due, the payment of the premiums shall be a debt due.

13.4 Alterations to the terms of insurance shall not be made without the approval of the Employer.

13.5 Both Parties shall comply with any conditions of the insurance policies.

14. Site Investigation Reports:

14.1 The Contractor, in preparing the tender, shall rely on any site investigation reports referred to in the Contract data, supplemented by any information available to the Tenderer.

15. Queries about the Contract Data

15.1 The Employer will clarify queries on the Contract Data.

16. Contractor to construct the Works

16.1 The Contractor shall construct the Works in accordance with the Specification and Drawings.

17. The Works to be completed by the Intended Completion Date

17.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the program submitted by the Contractor, as updated with the approval of the Employer, and complete them by the Intended Completion Date.

18. Approval by the Employer:

18.1 The Contractor shall submit Specification and drawings showing the proposed Temporary Works to the Employer, who is to approve them if they comply with the Specifications and Drawings.

18.2 The Contractor shall be responsible for the design of Temporary Works

18.3 The Employer’s approval shall not alter the Contractor’s responsibility for design of the Temporary Works.

18.4 The Contractor shall obtain approval of third parties to the design of third parties to the design of the temporary Works where required.

18.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Employer before their use.

19. Safety

19.1 The Contractor shall be responsible for the safety of all activities on the Site.

20. Discoveries

20.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site is the property of the Employer. The Contractor is to notify the Employer of such discoveries and carry out the Employer's instructions for dealing with them.

21. Possession of the Site

21.1 The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the Contract Data the Employer is deemed to have delayed the start of the relevant activities and this will be Compensation Event.

22. Access to the Site

22.1 The Contractor shall allow the Employer and any person authorized by the Employer access to the Site, to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured / fabricated / assembled for the works.

23. Instructions

23.1 The Contractor shall carry out all instructions of the Employer which comply with the applicable laws where the Site is located.

24. Procedure for resolution of Disputes:

24.1 If the Contractor is not satisfied with the decision taken by the Employer, the dispute shall be referred by either party to Arbitration within 30 days of the notification of the Employer's decision.

24.2 If neither party refers the dispute to Arbitration within the above 30 days, the Employer's decision will be final and binding.

24.3 The Arbitration shall be conducted in accordance with the arbitration procedure stated in the Special Conditions of Contract.

B. Time Control

25. Program

25.1 Within the time stated in the Contract Data the Contractor shall submit to the Employer for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works.

25.2 The Employer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Employer again at any time. A revised Program is to show the effect of Variations and Compensation Events.

26. Extension of the Intended Completion Date

26.1 The Employer shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date.

26.2 The Employer shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Employer for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information.

27. Delays ordered by the Employer

27.1 The Employer may instruct the Contractor to delay the start or progress of any activity within the Works.

28. Management meetings

28.1 The Employer may require the Contractor to attend a management meeting. The business of a management meeting shall be to review the progress achieved and the plans for remaining work.

28.2 The responsibility of the parties for actions to be taken is to be decided by the Employer either at the management meeting or after the management meeting and stated in writing to be distributed to all who attended the meeting.

C. Quality Control

29. Identifying defects

29.1 The Employer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Employer may instruct the Contractor to search for a Defect and to uncover and test any work that the Employer considers may have a Defect

30. Tests

30.1 If the Employer instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect the test shall be a Compensation Event.

31. Correction of defects

31.1 The Employer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion and is defined in the Contract Data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

31.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Employer’s notice.

32. Uncorrected defects

32.1 If the Contractor has not corrected a Defect within the time specified in the Employer’s notice, the Employer will assess the cost of having the Defect corrected, and the Contractor will pay this amount.

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3 D. Cost Control

33. Bill of Quantities (BOQ)

33.1 The BOQ shall contain items for the construction, installation, testing, and commissioning work to be done by the Contractor.

33.2 The BOQ is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the BOQ for each item

34. Variations

34.1 The Employer shall have power to order the Contractor to do any or all of the following as considered necessary or advisable during the progress of the work by him

(a) Increase or decrease of any item of work included in the Bill of Quantities (BOQ);
(b) Omit any item of work;
(c) Change the character or quality or kind of any item of work;
(d) Change the levels, lines, positions and dimensions of any part of the work;
(e) Execute additional items of work of any kind necessary for the completion of the works; and
(f) Change in any specified sequence, methods or timing of construction of any part of the work.

34.2 The Contractor shall be bound to carry out the work in accordance with any instructions in this connection, which may be given to him in writing by the Employer and such alteration shall not vitiate or invalidate the contract.

34.3 Variations shall not be made by the Contractor without an order in writing by the Employer, provided that no order in writing shall be required for increase or decrease in the quantity of an item appearing in the BOQ so long as the work executed conforms to the approved drawings.

34.4 The Contractor shall promptly request in writing the Employer to confirm verbal orders and the officer issuing oral instructions shall confirm it in writing with in 30days, failing which the work shall be carried out as though there is no variation. In case variation is approved, it shall be accompanied by BOQ, failing which the contractor shall be responsible for deviation, if any. Further, approval of the Board has to be obtained for the variation exceeding 5%.

35. Payments for Variations

35.1 Payment for increase in the quantities of an item in the BOQ up to 25% of that provided in the Bill of Quantities shall be made at the rates quoted by the Contractor.

35.2 For quantities in excess of 125% of the tendered quantity of an item as given in the BOQ, the Contractor shall be paid at the rate entered in or derived from in the Schedule of Rates (applicable for the area of the work and current at the time of award of contract) plus or minus the overall percentage of the original tendered rates over the current Schedule of Rates prevalent at the time of award of contract.

35.3 If there is no rate for the additional, substituted or altered item of the work in the BOQ, efforts would be made to derive the rates from those

given in the BOQ or the Schedule of Rates (applicable for the area of the work and current at the time of award of contract) and if found feasible the payment would be made at the derived rate for the item plus or minus the overall percentage of the original tendered rates over the current Schedule of Rates prevalent at the time of award of contract

35.4 If the rates for additional, substituted or altered item of work cannot be determined either as at 35.1 or 35.2 or 35.3 above, the Contractor shall be requested to submit his quotation for the items supported by analysis of the rate or rates claimed, within 7 days.

1 35.5 If the Contractor's quotation is determined unreasonable, the Employer may order the Variation and make a change to the Contract Price which shall be based on Employer’s own forecast of the effects of the Variation on the Contractor's costs.

35.6 If the Employer decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.

35.7 Under no circumstances the Contractor shall suspend the work on the plea of non-settlement of rates for items falling under this Clause.

36. Submission of bills for payment

36.1 The Contractor shall submit to the Employer monthly bills of the value of the work completed less the cumulative amount paid previously.

36.2 The Employer shall check the Contractor's bill and determine the value of the work executed which shall comprise of (i) value of the quantities of the items in the BOQ completed and (ii) valuation of Variations and Compensation Events.

36.3 The Employer may exclude any item paid in a previous bill or reduce the proportion of any item previously paid in the light of later information.

37. Payments

37.1 Payments shall be adjusted for deductions for advance payments, other recoveries in terms of the contract and taxes, at source, as applicable under the law. The Employer shall pay the Contractor the within 60 days of submission of bill. The Contractor shall be liable to pay liquidated damages for shortfall in progress. For Progress beyond the agreed programme, payment is subject to availability of the grants.

37.2 Items of the Works for which no rate or price has been entered in will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

38. Compensation events

38.1 The following are Compensation events unless they are caused by the Contractor:

(a) The Employer does not give access to a part of the Site by the Site Possession Date stated in the Contract Data.

(b) The Employer orders a delay or does not issue drawings, specifications or instructions required for execution of works on time.

(c) The Employer instructs the Contractor to uncover or to carry out additional tests upon work which is then found to have no Defects.

(d) The Employer gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons.

(e) The effect on the Contractor of any of the Employer's Risks.

(f) The Employer unreasonably delays issuing a Certificate of Completion.

(g) Other Compensation Events listed in the Contract Data or mentioned in the Contract.

38.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date is extended. The Employer shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

38.3 As soon as information demonstrating the effect of each Compensation event upon the Contractor's forecast cost has been provided by the Contractor, it is to be assessed by the Employer and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Employer shall adjust the Contract Price based on Employer's own forecast. The Employer will assume that the Contractor will react competently and promptly to the event.

38.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor not having given early warning or not having cooperated with the Employer.

39. Tax

39.1 The rates quoted by the Contractor shall be deemed to be inclusive of the sales and other taxes that the Contractor will have to pay for the performance of this Contract. The Employer will perform such duties in regard to the deduction of such taxes at source as per applicable law.

40. Price Adjustment:

40.1 Contract price shall be adjusted for increase or decrease in rates and prices of materials, fuels and lubricants in accordance with the following principles and procedures and as per formulae given in the Contract Data.

1 (a) The price Adjustment shall apply for the work done from the date of commencement up to the end of original period of

completion or extensions granted by the Employer and shall not apply to work carried out beyond the stipulated period of completion for reasons attributable to the Contractor;

2 (b) Price Adjustment shall be admissible from the date of opening of tenders (original or extended)

3 (c) The price adjustment shall be determined during each quarter from the formulae given in Contract Data.

4 (d) Following expressions and meanings are assigned to the work done during the quarter:

R = Total value of work done during the quarter. It will exclude value for works executed under variations for which price adjustment (if any) will be worked out separately based on the terms mutually agreed.

40.2 To the extent that full compensation for any rise or fall in costs to the contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates included in the contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.

41. Liquidated damages

41.1 The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the Contract Data for each day that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestone as stated in the Contract Data). The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages does not affect the Contractor's liabilities.

41.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Employer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment of bill.

42. Advance Payments:

42.1 The Employer shall make payment to the Contractor of the amounts stated in the Contract Data by the date stated in the Contract Data, against provision by the Contractor of an unconditional bank guarantee in a form acceptable to the Employer issued by a Nationalized/Scheduled Bank in amounts equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest will not be charged on the advance payment.

42.2 The Contractor is to use the advance payment only to pay for Mobilization expenses required specifically for execution of the Works. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Employer.

1 42.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the

schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuation of the work done, variations, price adjustments, compensation events or liquidated damages.

43. Securities:

43.1 The Security deposit (including additional security for unbalanced tenders) shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and type of instrument acceptable to the Employer. The Security deposit shall be valid until a date 30 days from the date of expiry of Defects Liability Period and the additional security for unbalanced tenders shall be valid until a date 30 days from the date of issue of the certificate of completion.

44. Cost of Repairs:

44.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

E. Finishing the Contract

45. Completion

45.1 The Contractor shall request the Employer to issue a Certificate of Completion of the Works and the Employer will do so upon deciding that the Work is completed.

46. Taking over

46.1 The Employer shall take over the Site and the Works within seven days of issuing a certificate of Completion.

47. Final account

47.1 The Contractor shall supply to the Employer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Employer shall issue a Defect Liability Certificate and certify any final payment that is due to the Contractor within 90 days of receiving the Contractor's account if it is correct and complete. If it is not, the Employer shall issue within 90 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Employer shall decide on the amount payable to the Contractor and make payment within 60 days of receiving the Contractor’s revised account.

48. As built drawings and /or Operating and Maintenance Manuals

48.1 If "as built"[5] Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the Contract Data.

48.2 If the Contractor does not supply the Drawings by the dates stated in the Contract Data, or they do not receive the Employer's approval, the Employer shall withhold the amount stated in the Contract Data from payments due to the Contractor.

49. Termination

49.1 The Employer may terminate the Contract if the other party causes a fundamental breach of the Contract.

49.2 Fundamental breaches of Contract include, but shall not be limited to the following:

(a) the Contractor stops work for 45 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Employer;

(b) The Contractor becomes bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(c) the Employer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Employer;

(d) the Contractor does not maintain a security which is required;

(e) the Contractor has delayed the completion of works by the number of days for which the maximum amount of liquidated damages can be paid as defined in the Contract data; and

(f) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in the executing the Contract.

For the purpose of this paragraph : "corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in contract execution. "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Borrower, and includes collusive practice among Tenderers (prior to or after Tender submission) designed to establish Tender prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition."

49.3 When either party to the Contract gives notice of a breach of contract to the Employer for a cause other than those listed under Sub Clause 49.2 above, the Employer shall decide whether the breach is fundamental or not.

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[5]

Contractor
Employer

49.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.

49.5 If the Contract is terminated the Contractor shall stop work immediately, make the Site safe and secure and leave the Site as soon as reasonably possible.

50. Payment upon Termination

50.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Employer shall prepare bill for the value of the work done less advance payments received up to the date of the bill, less other recoveries due in terms of the contract, less taxes due to be deducted at source as per applicable law and less the percentage to apply to the work not completed as indicated in the Contract Data. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor the difference shall be a debt payable to the Employer.

50.2 If the Contract is terminated at the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Employer shall prepare bill for the value of the work done, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the certificate, less other recoveries due in terms of the contract, and less taxes due to be deducted at source as per applicable law and make payment accordingly.

51. Property

51.1 All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the Employer, if the Contract is terminated because of a Contractor’s default.

52. Release from performance

52.1 If the Contract is frustrated by any event entirely outside the control of either the Employer or the Contractor the Employer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which commitment was made

F. Special Conditions of Contract

1. Labour :

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

The Contractor shall, if required by the Employer, deliver to the Employer a return in detail, in such form and at such intervals as the Employer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such other information as the Employer may require.

2. Compliance with labour regulations :

During continuance of the contract, the Contractor and his sub contractors shall abide at all times by all existing labour enactments and rules made there under, regulations, notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the Contractor, Employer shall have the right to deduct any money due to the Contractor including his amount of security deposit. The Employer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

3. Protection of Environment:

The contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation. During continuance of the contract, the contractor and his sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority.

4. Arbitration (Clause 24)

4.1 The procedure for arbitration shall be as follows:

(a) In case of dispute or difference arising between the Employer and the Contractor relating to any matter arising out of or

connected with this agreement it shall be settled in accordance with the Arbitration and Conciliation Act 1996. The disputes or differences shall be referred to a Sole Arbitrator. The Sole Arbitrator shall be appointed by agreement between the parties; failing such agreement, by the Appointing Authority (any one of the Organizations as per list enclosed in Annexure)

(b) Arbitration proceedings shall be held at ***Bangalore***, Karnataka, India

(c) The cost and expenses of arbitration proceedings will be paid as determined by the Arbitrator. However the expenses incurred by each party in connection with the preparation, presentation, etc., shall be borne by each party itself.

(d) Performance under the contract shall continue during the arbitration proceedings and payments due the Contractor by the Employer shall not be withheld, unless they are the subject matter of the arbitration proceedings.

5 Contractor to Co-ordinate his Work with Other Contractors

5.1 The Contractor has to co-ordinate with the other concerned Contractors as already specified in Conditions of Contract for all such works as per the directions of Engineer in charge at no extra cost.

6 **Continuation of Work:**

6.1 In case of the death of a contractor after executing the agreement / commencement of the work, his legal heir, if any eligible registered contractor and willing, can execute and complete the work at the accepted tender rates irrespective of the cost of the work

7. **Further the following conditions will also become part of the agreement which may please be noted.**

a) Rates quoted by the contractor / firm is inclusive of all taxes and duties.
b) The Contractor/Firm should mandatorily pay by themselves the necessary Entry Tax & other applicable taxes without fail.
c) All applicable taxes payable in respect of work shall be paid by the contractor / firm to the necessary departments.
d) Any Outstanding amount in the form of taxes be paid including interest, penalty etc.,
e) Details of Taxes recovered in the bills shall be collected in the prescribed forms from time to time.
f) The contractor is being informed that, Government of India has introduce GST taxation from 1st July 2017 and due to this, if there is any increase in taxes, Board will reimburse the same. If there is any reduction in the taxes the firm has to reimburse / pay back such taxes to the Board to such extent.
g) Materials purchased with regards to work contract, the Board will not issue e-Sugam numbers.
h) Exemption of Excise duty, custom duty and any other claimed by the contractor / firm while purchasing material required for the work

should be refunded to the Board or otherwise such amount will be recovered from the contractor / firm bills if not paid to the Board.

i) All taxes payable in respect of work shall be paid by the contractor / firm and Board is not responsible for this.
j) Any clarification required in this regard shall be obtained from this office during office hours.
k) The rates quoted in the tender offer shall be by considering the benefits of concession rate of Central Sales Tax (For all interstate procurement of materials only) as per Section *(1) of the CST Act, 1956. Necessary Form 'C' will be issued by Board. If abolished after the GST, then the same will not apply.
l) The quality of work will be monitored by 'Third Party Agency' and the Third party will be nominated by BWSSB.

Annexure:

LIST OF ORGANIZATIONS WHO ARE CONSIDERED AS APPOINTING AUTHORITY FOR APPOINTMENT OF ARBITRATORS[32]

1. 1. Indian Council of Arbitration, New Delhi;
2. 2. International Centre for Alternative Disputes Resolution (India);
3. 3. Indian Roads Congress;
4. 4. Indian Building Congress;
5. 5. Indian Institute of Bridge Engineers;
6. 6. Indian Institute of Public Health Engineers;
7. 7. Institute of Water Works

[32] Add any other Organization considered suitable.

SECTION 6:

CONTRACT DATA

CONTRACT DATA

Items marked "N/A" do not apply in this Contract.

The following documents are also part of the Contract: Clause Reference

- The Schedule of Operating and Maintenance Manuals [48]
- The Methodology and Program of Construction [25]
- Site Investigation Reports [14]
- The Schedule of Key and Critical Equipment to be deployed on the work as per agreed program of construction. [25]

The Employer is :

Name: **Bangalore Water Supply & Sewerage Board**
Represented by Engineer-In-Chief [1.1]

Address: Bangalore Water Supply & Sewerage Board
2nd floor, Cauvery Bhavan
K.G.Road, Bangalore -560009

Name of authorized Representative: **Executive Engineer UFW-2**
BWSSB, Suvarna Bhavan,
Bangalore.

The name and identification number of the Contract is : Work of Rehabilitation and Repair works to 11ML capacity RCC Circular GLR under Banagiri Service Station of AEE(SW-4) Sub Division.

The Works consist of Rehabilitation and repair works at Banagiri.

The start date shall be the date of issue of notice to proceed with the work. [1.1]

The Intended Completion Date for the whole of the Works is ***18 Months*** with the following milestones [17, 26]
Milestone dates: [41]

	Physical works to be completed	Period
Milestone 1	Construction of retaining wall, strengthening measures for GLSR floor and wall , 30% of the Shortcreating work to SSM wall shall be completed for GLR.	Nine Months for the date of agreement.
Milestone 2	Rehabilitation and repair works of GLR work should be completed in all respect	Eighteen Months for the date of agreement.

Contractor
Employer

	including fixing of Inlet & Out let valves.	

The Site Possession Date is: 15 days [21]

The Site is located at Banagiri in the premises of Assistant Executive Engineer, SW-4 Sub-Division, Bangalore.

[1.1]

and is defined in drawings nos.

The Defects Liability Period is **365** days [31]

Insurance requirements are as under: [13]

Type of Cover		Minimum Cover for Insurance
(i)	Works and of Plant and materials	The sum stated in the Agreement plus 20%
(ii)	Loss or damage to equipment	Full replacement cost
(iii)	Loss or damage to property of Third Party	Full replacement cost
(iv)	Personal injury or death insurance (a) for Third Party	Rs. 20.00 Lakh
	(b) for Contractor's employees or labour	In accordance with the statutory requirements applicable to Karnataka

Price Adjustment Formula [40]

R =Value of work as defined in Clause 40.1 of Conditions of Contract.

Adjustment for labour component

(i) Price adjustment for increase or decrease in the cost due to labour shall be paid in accordance with the following formula:

$V_L = 0.85 \times P_l/100 \times R \times (L_i - L_o)/L_o$ Where,

V_L = increase or decrease in the cost of work during the quarter under consideration due to changes in rates for local labour.

L_o = the average consumer price index for industrial workers for Bangalore centre for the quarter preceding the date of opening of Bids as published by Labour Bureau, Ministry of Labour, Government of India.

L_i = The average consumer price index for industrial workers for Bangalore centre for the quarter under consideration as published by Labour Bureau, Ministry of Labour, Government of India.

P_l = Percentage of labour component of the work.

Adjustment for cement component

(ii) Price adjustment for increase or decrease in the cost of cement procured by the contractor shall be paid in accordance with the following formula.

$V_c = 0.85 \times P_c/100 \times R \times (C_i - C_o)/C_o$, Where

V_c = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for cement

C_o = The all India average wholesale price index for **Grey cement** for the quarter preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi.

C_i = The all India average wholesale price index for **Grey cement** for the quarter under consideration as published by Ministry of Industrial Development, Government of India, New Delhi

P_c = Percentage of cement component of the work

Note: *Index for all types of cement shall be considered from Cement –Group provided in the web site www.eaindustry.nic.in.*

Adjustment for steel reinforcement component

(iii) Price adjustment for increase or decrease in the cost of steel procured by the Contractor shall be paid in accordance with the following formula:

$V_s = 0.85 \times P_s/100 \times R \times (S_i - S_o)/S_o$

V_s = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for steel

S_o = The all India average wholesale price index for steel (**Steel Rods**) for the quarter preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi

S_i = The all India average wholesale price index for steel (**Steel Rods**) for the quarter under consideration as published by Ministry of Industrial Development, New Delhi

P_s = Percentage of steel reinforcement component of the work

Note: For the application of this clause, index of **Steel Rods** has been chosen to represent steel group for general construction *in the web site www.eaindustry.nic.in*

Adjustment for MS pipe component

(v) Price adjustment for increase or decrease in the cost of steel procured by the Contractor shall be paid in accordance with the following formula:

$V_s = 0.85 \times P_{ms}/100 \times R \times (S_i - S_o)/S_o$

V_s = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for steel

S_o = The all India average wholesale price index for steel (**Steel Plates**) for the quarter preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi

S_i = The all India average wholesale price index for steel (**Steel Plates**) for the quarter under consideration as published by Ministry of Industrial Development, New Delhi

P_{ms} = Percentage of MS pipe component of the work

Note: For the application of this clause, index of **Steel plates** has been chosen to represent steel group for general construction.

Adjustment of POL (fuel and lubricant) component

(v) Price adjustment for increase or decrease in cost POL (fuel and lubricant) shall be paid in accordance with the following formula:

$V_f = 0.85 \times P_f/100 \times R \times (F_i - F_o)/F_o$

V_f = Increase or decrease in the cost of work during the quarter under consideration due to changes in rates for fuel and lubricants.

F_o = The average official retail price of High Speed Diesel (HSD) at the existing consumer pumps of IOC at Bangalore on the day thirty days prior to the date of opening of Bids.

F_i = The average official retail price of HSD at the existing consumer pumps of IOC at Bangalore for the 15th day of the middle calendar month of the quarter under consideration.

P_f = Percentage of fuel and lubricants component of the work.

Note: **For the application of this clause, the price of High Speed Diesel oil has been chosen to represent fuel and lubricants group.**

Adjustment for Plant and Machinery Spares component

(vi) Price adjustment for increase or decrease in the cost of plant and machinery spares procured by the Contractor shall be paid in accordance with the following formula:

$V_p = 0.85 \times P_p/100 \times R \times (P_i - P_o)/P_o$

V_p = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for plant and machinery spares

P_o = The all India average wholesale price index for heavy machinery and parts for the quarter preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi

P_i = The all India average wholesale price index for heavy machinery and parts for the quarter under consideration as published by Ministry of Industrial Development, New Delhi

P_p = Percentage of plant and machinery spares component of the work

Note: **For the application of this clause, index of Heavy Machinery and Parts has been chosen to represent the Plant and Machinery Spares group.**

Adjustment of Local materials

(vii) Price adjustment for increase or decrease in cost of local materials other than cement, steel, bitumen and Fuel & Lubricants procured by the contractor shall be paid in accordance with the following formula:

$V_m = 0.85 \times P_m/100 \times R \times (M_i - M_o)/M_o$, Where

V_m = Increase or decrease in the cost of work during the quarter under consideration due to changes in rates for local materials other than cement, steel, bitumen and POL.

M_o = The all India average wholesale price index (all commodities) for the quarter preceding the date of opening of Bids, as published by the Ministry of Industrial Development, Government of India, New Delhi.

M_i = The all India average wholesale price index (all commodities) for the quarter under consideration as published by Ministry of Industrial Development, Government of India, New Delhi.

P_m = Percentage of local material component (other than cement, steel, bitumen and POL) of the work.

The following percentages will govern the price adjustment for the entire contract:

1.	Cement - P_c	**Will be intimated at the time of Agreement**
2.	Steel Reinforcement - P_s	**-do-**
3.	MS Pipe – P_{ms}	**-do-**
4.	Labour – P_l	**-do-**
5.	Fuel & Lubricants - P_f	**-do-**
6.	Plant & Machinery Spares - P_P	**-do-**
7.	Other materials - P_m	**-do-**

The liquidated damages for the whole of the works are
Rs. ***0.1%*** per day of the contract value and that for the milestones are as under:

For Mile stone 1: Rs. 0.1% per day of the contract value pertaining to this mile stone*
For Mile stone 2: Rs. 0.1% per day of the contract value pertaining to this mile stone*

* Mention the value at the time of agreement
The maximum amount of liquidated damages for the whole of the works is ten percent of final contract price. [41]
The amounts of the advance payment are: [42]

Nature of Advance	Amount (Rs.)	Conditions to be fulfilled
1. Mobilization	5% of the Contract price	On submission of un-conditional Bank Guarantee. (to be drawn before end of 30 days)

Repayment of advance payment for mobilization : [42]

The advance loan shall be repaid with percentage deductions from the interim payments certified by the Engineer under the Contract. Deductions shall commence in the next Interim Payment Certificate following that in which the total of all such payments to the Contractor has reached not less than 15 percent of the Contract Price or 3 months from the date of payment of first installment of advance, whichever period concludes earlier, and shall be made at the rate of 7.5 percent of the amounts of all Interim Payment Certificates until such time as the loan has been repaid, always provided that the loan shall be completely repaid prior to the expiry of the original time for completion pursuant to Clauses 17 and 26.

The date by which “as-built” drawings (colored drg. to appropriate scale in A-0 size) in 6 sets (Both hard copy and a soft copy) are required is within 30 days of issue of certificate of completion of Whole or Section of the Work as the case may be. [48]

The date by which Operating and Maintenance Manuals are required is within 30 days of issue of certificate of completion of Whole or Section of the Work as the case may be. [48]

The amount to be withheld for failing to supply “as built” drawings or supply of Operation and Maintenance Manuals by the date required is Rs.2,00,000/- [48]

The following events shall also be fundamental breach of the contract : [49.2]

1. The contractor has contravened Sub-clause 7.1 and Clause 9 of CC.

The percentage to apply to the value of the work not completed representing the Employer's additional cost for completing the Works shall be ***30*** percent. [50.1]

SECTION 7:

TECHNICAL SPECIFICATIONS

PART 7 - A

GENERAL REQUIREMENTS - CIVIL

7.A.1 Scope of Work.

The scope of work under this Contract includes the following but not limited to:

The rehabilitation work needs to be taken up for 4.5 MG new tank which is already not in service. It is also necessary to take up the work of providing replacement of WPC with Yelahanka tiles for the other tank which is already in service.

1.1.1 All necessary preliminary preparatory works to initiate the rehabilitation and repair works
1.1.2 Dismantling existing weather proof course, cement wearing coat of inside and outside of existing GLR.
1.1.3 Dismantling of floor, damaged portion of roof of reservoir.
1.1.4 Treatment for subsoil and flooring (near the leakage region i.e 1st and 2nd bay of eastern side)
1.1.5 Treatment for cracks in stone masonry wall
1.1.6 Treatment for corrosion affected (severely distressed) ceiling slab.
1.1.7 Treatment for locally damaged regions of RC members
1.1.8 Treatment for water proofing course over roof slab.
1.1.9 Construction of retaining wall as part of rehabilitation works.
1.1.10 Fixing of UPVC Ventilators and other allied works.
1.1.11 Disposal of surplus excavated and dismantled stuff.
1.1.12 Supplying and fixing of sluice valves, Mild Steel Specials etc.
1.1.13 Allied material testing and laboratory investigations as required to ensure the quality parameters as stipulated in tender document or as mandatory required as per Indian Standard Specifications.
1.1.14 Any other allied works to successfully complete the rehabilitation and repair works of the reservoir as per the instructions of Engineer in Charge.
1.1.15 Necessary testing and commissioning of rehabilitated and repaired reservoir to the full satisfaction of the Engineer in Charge.

Above scope of works should be read in conjunction with detailed specifications and Bill of Quantities for the work as specified elsewhere in the bid document.

1.2 Tender Drawings and Contract Documents

A list of the Tender Drawings is given in Volume 4 of this tender document. These drawings are made for tenderer's guidance only. "Released for Construction and Rehabilitation work" drawings will be issued to the Contractor during the progress of work. "Released for Construction and Rehabilitation work" drawings may be revised and revised copies will be issued to the Contractor during the execution of the Works. "Released for Construction and Rehabilitation work" drawings will progressively be issued during the construction, broadly conforming to the basic scheme indicated in the Specification drawings.

No claim will be entertained on the score that the details shown on "Released for Construction and Rehabilitation work" drawings are different from those shown on the Specification Drawings, unless the drawings indicate such items of work which are not a part of the Bill of Quantities.

The Contractor shall be furnished, free of charge, two certified true copies of the Contract Documents and all further drawings which may be issued during the progress of work as aforesaid. He shall keep one copy of these documents on the Site in good order and the same shall at all reasonable times be available for inspection and use by the Engineer, his representative, or other inspecting officers.

None of these documents shall be used by the Contractor for any purpose other than that of the Contract.

The documents and drawings issued as above remain the property of the Board and shall be returned to the Engineer not later than the end of the Defects Liability Period.

7.A.2 Programme of Works

No extension of time will be granted by the Engineer in respect of inclement weather or its effects (such as floods or droughts), fire or industrial disputes, unless such events could not reasonably have been foreseen by an experienced Contractor. All allowances to guard against such delays shall be clearly indicated in his programme.

As soon as practicable after the acceptance of his tender and in any case before starting work on the site, the Contractor shall submit for

the Engineer's approval a detailed Programme of Works in the form of a PERT/CPM Network and a bar chart together with description of his proposed method of working. The programme of the other contracts which are having interface with the present contract will be supplied to the Contractor prior to the commencement of works for proper planning and coordination with other contractors.

7.A.3 Progress

The Contractor shall regularly review his programme in the light of the progress actually achieved and shall submit for approval, updated PERT/CPM Network and bar charts at three months interval. If the progress fails behind that needed to ensure timely achievement of specified milestones, the Contractor shall submit proposals for improving his methods and pace of working to the satisfaction of the Engineer and shall carry out such measures which are needed to ensure that the Works are completed on time.

7.A.4 Meetings

From time to time the Engineer will call meetings in his office or at the Contractor's office, or at the Site, as he deems necessary, to discuss progress and any technical points requiring settlement. The Contractor's Representative or responsible representative shall attend such meetings.

The Contractor shall prepare and submit to the Engineer a daily activity report summarizing the main activities undertaken each day.

7.A.5 Photographs

The Contractor shall supply negatives of photographs and unmounted positive colour prints not less than 250 x 200 mm of such portions of the Works, in progress and completed, as may be directed by the Engineer and specified herein. The negatives and prints shall not be retouched. The negative of each photograph shall be the property of the Employer and shall be delivered to the Engineer with the prints. No prints of these negatives shall be supplied to any other person without the written permission of the Engineer.

The photographs shall be of two categories:

- progress photographs (quarterly basis)
- record photographs.

Both categories of photographs shall be properly referenced to the approval of the Engineer, and on the back of each print shall be

recorded the date and time of the photograph, the direction in which the camera was facing, an identifying description of the subject and the reference.

Photographs taken for record purposes as ordered by the Engineer or as specified herein shall be supplied with three prints, having the reverse of one subscribed with the signatures and seal of the Contractor and the Engineer (or their authorized representatives) for the purpose of attestation. If required, the Contractor may at his own expense have an additional print similarly attested for his retention.

The Contractor shall supply one negative and three prints of each progress photograph ordered by the Engineer. The Contractor shall supply two additional prints of progress photographs selected by the Engineer for incorporation in albums. The Contractor shall supply two sets of albums, mount the prints, and title the prints and albums all to the approval of the Engineer.

Taking of photographs of the Works by the Contractor for any other purpose whether for use in India or in any other country shall not be carried out without written approval from the Engineer.

7.A.6 Site Labor and Supervision

The Contractor shall provide all the skilled and unskilled labor required, and all necessary tools and equipment's for execution of the Works within the period agreed in the program.

The Contractor shall not remove any supervisory staff or skilled labor from the Site without the Engineer's prior approval.

7.A.7 Sub-letting

The Contractor shall not sub-let the whole of the Works. Where any part of the Works is sub-let, the Contractor shall not be relieved of his obligation under the Contract. The Contractor shall be responsible for the acts, defaults and neglect acts in the Works of any sub-contractor, as if they were his own.

Where the Engineer has consented to sub-contractors proposed by the Contractor, such manufacturers or sub-contractors shall not be changed without the prior approval in writing of the Engineer.

A copy of every sub-order shall be sent to the Engineer at the time the order is placed each clearly marked with the title of the Contract and the Contract number.

7.A.8 Languages

All drawings, instructions, signs, notices, name-plates, etc. for use in the Works shall be in English / Kannada.

All site sign boards and warning signs shall be in Kannada and English.

7.A.9 Notice of Operations

The Contractor shall give full and complete written notice of all important operations to the Engineer sufficiently in advance to enable the Engineer to make such arrangements as the Engineer may consider necessary for inspection and for any other purpose. The Contractor shall not start any important operation without the written approval of the Engineer.

7.A.10 Protection of Existing Installations

The Contractor shall apply to the Engineer in writing at least 28 days before starting any work that involves interference with existing structures, equipment, etc. The Contractor shall not execute such work until he has received permission to proceed in writing from the Engineer.

The Contractor shall ensure that no earth, debris or rock is deposited on public or private roads or rights of way as a result of the Works and all vehicles leaving the Site shall be cleaned accordingly.

7.A.11 Fencing, watching and lighting

The Contractor shall provide and maintain at his own expense all lights, guards, fencing and watching when and where necessary or as required by the Engineer for the safety and conveniences of those employed on the works or the public.

7.A.12 Protection of Existing Public and Private Services

The Contractor shall notify all public authorities, utility companies and private owners of proposed works that will affect them not less than two weeks before commencing the works.

The Contractor shall adequately protect, uphold, maintain and prevent damage to all services and shall not interfere with their operation without the prior consent of the public authorities, utility companies, private owners or the Engineer as appropriate.

If any damage to services results from the execution of the Works, the Contractor shall immediately:

(a) Notify the Engineer and appropriate public authority, utility company or private owner.
(b) Make arrangements for the damage to be made good without delay to the satisfaction of the public authorities, utility company or private owner as appropriate. The Contractor shall be liable for all costs for making good such damage.

The Engineer may issue instructions or make other such arrangements as he deems necessary, to repair rapidly any essential services damaged during the execution of the Contract. Such arrangements shall not affect any liability to pay for making good the damage.

7.A.13 Setting out the Works

The Engineer shall supply dimensioned drawings, levels and other information necessary to enable the Contractor to set out the Works, at his own cost, such as levelling instruments in good working condition, all pegs, ranging rods, long measuring rods, marked meters and decimeters and each meter and decimeter numbered, posts and sight-rails, boning rods, moulds, template etc., together with any reasonable number of labourers that may be required and set out the Works and be responsible for the accuracy of the same. The Contractor shall amend at his own cost and to the satisfaction of the Engineer any error found at any stage which may arise through inaccurate setting out unless such error is based on incorrect data furnished in writing by the Engineer, in which case the cost of rectification shall be borne by the Board. The Contractor shall protect and preserve all benchmarks used in setting out the Works till the end of the Defects Liability Period unless the Engineer directs its early removal. The Contractor should also keep the levelling instruments in good working condition throughout the period of construction work on site.

The checking of any setting out or of any line or level by the Engineer shall not in any way relieve the Contractor of his responsibility for the correctness thereof.

No separate payment will be made for setting out the Works as required. Unit rates quoted by the Contractor for all items will be deemed to have covered the expenses for such setting out.

7.A.15 Payments of items on lumpsum basis

Progressive payments against items in the Bill of Quantities where the payments are to be made on a “Lumpsum” basis, may be considered on specific proposals from Contractor. The mode of

payment will be decided by the Engineer in consultation with the Employer.

7.A.16 Building in Plant supplied under other Contracts

Plant erected under other Contracts if any, in connection with this project, which are required to be built into structures constructed under this Contract will be set to line and level, secured and fixed by the Plant Contractor by such means as will permit the Contractor to complete the building-in without disturbing the line and level of the plant so fixed. Maintaining the alignment during building-in will be the responsibility of the Plant Contractor.

Holes shall be left in concrete walls, floors, roofs, etc., as shown on the Drawings.

Plant and equipment such as pipes and valves supplied under other contracts for building-in by the Contractor shall wherever practicable, be built directly into the Works and any box-outs or holes formed for the convenience of the Contractor shall be made good properly and effectively after the inserts are placed in.

7.A.17 Preservation of Vegetation

The Contractor shall ensure that his employees, sub-contractors (and also their employees) shall not fetch firewood from the trees around the Site. The Contractor shall be liable for any penalties levied by the concerned authorities for infringement of this regulation.

7.A.18 Precautions for works in Thoroughfares

While the execution of any work is in progress in any street or thoroughfare, the Contractor at his own cost shall have adequate provision for the passage of traffic, for securing safe access to all premises approached from such street or thoroughfare, and for any drainage, water supply, or means of lighting or any other utility service which may be interrupted to reason of execution of the Work. Whenever it may be necessary to stop the traffic in any street or thoroughfare, permission must first be obtained from the Engineer and the Contractor shall then put up such barriers and adopt such other measures or take precautions as may be necessary or as the Engineer may direct for regulation of traffic. The work shall in such cases be executed night and day or for as long a period as practicable if so ordered by the Engineer, and with such speed and vigour as he may require, so that the traffic may be impeded for as short a time as possible. The Contractor shall remove the barriers as soon as the necessity for them has ceased. Care shall be taken by the

Contractor to cause the least possible obstruction to traffic during the progress of the work.

7.A.19 Maintenance of underground utility services

All the underground utility services such as water pipes, gas pipes, drains, sewers, cable etc., which may be met up in or about any excavation, shall if the Engineer deem it practicable, be properly maintained and protected by the Contractor himself or through other agency by means of shoring, strutting, planking over, padding or otherwise as directed by Engineer during the progress of the work without claiming any extra charge. Any damage to these underground utility services shall be immediately remedied by the Contractor or by the agency at his own cost, failing which the Engineer may with or without notice adopt such measures as he may deem necessary at the risk and cost of the Contractor.

If on the other hand, the Engineer considers impracticable for the Contractor to maintain any such underground utility services and that the exigencies of the work necessitate the breaking down, removal or diversion of the said services the cost of such breaking down, removal or diversion including that of rebuilding, replacing, diverting and reinstating of any such utility service shall be paid to the Contractor, if done by him. However, the cost of provisions, pumps, chutes or other appliances as the Engineer may direct for the raising or temporary passage of the water or sewage and the cost of pumping out or removing as often as the Engineer may direct, water or sewage which may escape from any such underground utility service, shall be borne by the Contractor.

7.A.20 Contractor to preserve peace

The Contractor shall at all times during the progress of the work take all requisite precaution and use his best endeavors for preventing any riotous or unlawful behavior by or amongst the workers and others employed on the Works and for the preservation of peace and protection of the inhabitants and the security of property in the neighborhood of the Works. He shall also pay the charges of such special police (if any) as the Engineer may deem necessary.

7.A.21 Connections to Existing Pipelines

The inlet and outlet pipelines constructed under this Contract shall be connected to the pipelines constructed under other contracts. The Contractor shall carry out all works connected with items like road

surface / pavement breaking, excavation, diverting the road where necessary, cutting, preparing 'V', grinding, filling, introducing appurtenances, major or minor fixtures, laying pipelines, welding, concreting, backfilling and consolidating, restoring the road / pavement, removing diversion etc., and any other connected items required for this, though not specifically mentioned herein. The Contractor shall arrange all construction equipment, tools, tackles, cranes, diesel generators and / or diesel driven equipment and standby equipment to ensure meeting the scheduled program. The Contractor shall prepare his program for this work and submit it for Engineer's review and approval.

7.A.22 Interface between Contracts

The interface between various contracts linked with this contract has been described in Part 1 of this Specifications. The Contractor shall coordinate fully with the relevant activities of the other Contractors as specified by the Engineer.

7.A.23 Contractor's office near the works

The Contractor shall have an office near the Works at which notice from the Employer or the Engineer may be served, and shall between the hours of sunrise and sunset on all working days have a clerk or some other authorized person always present at such office upon whom such notices may be served and service of any notices left with such clerk or any authorized person or at such office shall be deemed good upon the Contractor.

7.A.24 Effects of Weather

The Contractor shall ensure that no damage occurs to the works during construction by arranging adequate protection for excavations or building works against the effects of drought, sunshine, wind and rainfall (including erosion and flooding). No work shall be performed when in the opinion of the Engineer such work is liable to be injuriously affected by the weather. The Contractor shall have no claim against the BWSSB on account of loss alleged to have been sustained directly or indirectly by reason of the Engineer declining to permit such work to start or continue or ordering any work damaged by the weather to be made good or removed and re-executed.

End of Part 7A

EARTHWORKS

7.B.1 Drawings

Engineer will furnish drawings wherever, in his opinion, such drawings are required to show areas to be excavated/filled grade level, sequence of priorities etc. Contractor shall follow strictly such drawings.

7.B.2 General

The Contractor shall furnish all tools, plant, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Specifications.

The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as pipelines grading, basement, foundations, roads, drains, etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 8m intervals or

nearer, if necessary, based on ground profile and thereafter properly recorded.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

The rates quoted shall also include for dumping of excavated material in regular heaps, bunds, riprap with regular slopes within the lead specified and levelling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as approved by the Engineer. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

Topsoil shall be stock piled separately for later re-use.

7.B.4 Clearing

The area to be excavated/filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Engineer. Where earthfill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

7.B.5 Classification

All materials to be excavated shall be classified by Engineer, into one of the following classes and shall be paid for at the rate tendered for that particular class of material. No distinction shall be made whether the material is dry, moist or wet. The decision of Engineer regarding the classification of the material shall be final and binding on Contractor and not be a subject matter of any appeal or arbitration.

Any earthwork will be classified under any of the following categories :

a) Ordinary & Hard Soils

These shall include all kinds of soils containing kankar, sand, silt, moorum and/or shingle, gravel, clay, loam, peat, ash, shale, rock, boulders, slag, chalk, slate, hard micaschist, laterite, highly weathered granite gneiss and all other materials which can generally be excavated by spade, pick axes, shovel and pneumatic breaking equipment. This shall also include excavation in macadam and tarred roads and pavements. This shall also include rock boulders not

longer than 1 meter in any direction and not more than 500 mm in any one of the other two directions. Masonry to be dismantled will also be measured under this item.

b) Hard Rock

This shall include all rock occurring in large continuous masses which cannot be removed except by blasting or drilling with mechanical breakers. Boulders of rock occurring in such sizes and not classified under (a) above shall also be classified as hard rock. Concrete work both reinforced and unreinforced to be dismantled will be measured under this item, unless a separate provision is made in the Schedule of Quantities.

7.B.6 Excavation

All excavation work shall be carried out by mechanical equipment unless, in the opinion of Engineer, the work involved requires it to be carried out by manual methods.

Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawings provided by the Contractor or such other lines and grades as may be agreed with the Engineer. Rough excavation shall be carried out to a depth of 150mm above the final level. The balance shall be excavated with special care. Soft pockets shall be removed below the final level and extra excavation filled up with lean concrete as approved by the Engineer. The final excavation should be carried out just prior to laying the blinding course.

Contractor may, for facility of work or similar other reasons excavate, and also backfill later, if so approved by Engineer, at his own cost outside the lines shown on the drawings or directed by Engineer. Should any excavation be taken below the specified elevations, Contractor shall fill it up, with concrete of the same class as in the foundation resting thereon, upto the required elevation. No extra shall be claimed by Contractor on this account.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Engineer shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

Removal of the slipped earth will not be paid for if the slips are due to the negligence of Contractor.

7.B.7 Stripping Loose Rock

All loose boulders, detached rocks partially and other loose material which might move therewith not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of Engineer, to fall or otherwise endanger the workmen, equipment, or the work shall be stripped off and removed from the area of the excavation. The method used shall be such as not to render unstable or unsafe the portion which was originally sound and safe.

Any material not requiring removal in order to complete the permanent works, but which, in the opinion of Engineer, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed. The cost of such stripping will be paid for at the unit rates accepted for the class of materials in question.

7.B.8 Excavation in Hard Rock

Excavation in hard rock shall be only by chiselling / Jack hammering or by drilling with mechanical brakers.

The rock shall be removed by wedging, pick, boring, heating and quenching or other approved non-blasting methods. All loose or loosened rock in the sides shall be removed by barring, wedging etc. The unit rate for excavation in hard rock shall include the cost of all these operations. No blasting is allowed.

7.B.9 Fill, Backfilling and Site Grading

General

All fill material shall be subject to the Engineer’s approval. If any material is rejected by Engineer, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Engineer after the fill work is completed.

No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Engineer.

The Contractor shall not commence the placement of any fill or back fill at any location without the approval of the Engineer.

Material

To the extent available, selected surplus soils from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or

removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Engineer. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Top soil containing foreign material shall be removed. The materials so removed shall be disposed off as directed by Engineer. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist, at his cost.

Filling in pits and trenches around foundations of structures, walls, etc.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc., shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Engineer. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Engineer is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to a proper profile to the approval of the Engineer.

Sand Filling in Plinth and Other Places

Where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours and drained to ensure maximum hydraulic compaction. Any temporary work required to contain sand under flooded condition shall be on Contractor’s account. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer has inspected and approved the fill.

Filling in Trenches

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. The backfilling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes.

Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centre line of the pipe shall be done

by hand compaction with selected approved earth in layers not exceeding 8 cm; backfilling above the level of the centre line of the pipes shall be done with selected earth by hand compaction, or other approved means in layers not exceeding 15 cm.

In case of excavation of trenches in rock, the filling up to a level 30 cm above the top of the pipe shall be done with approved excavated soil. The filling up to the level of the centre line of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the centre line of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

7.B.10 General Site Grading

Site grading shall be carried out as indicated in the drawings and as approved by the Engineer. Excavation shall be carried out as specified in the Specifications. Filling and compaction shall be carried out as specified under Clause 6.9 and elsewhere unless otherwise indicated below.

The fill shall be placed in layers not exceeding 200 mm and levelled uniformly and compacted as indicated in Clause 6.9 before the next layer is deposited.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor at his cost.

Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. This shall hold good for embankments as well. The fill will be considered as incomplete if the desired compaction has not been obtained.

The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected material and make good the slip at his cost.

If so specified, the rock as obtained from excavation may be used for filling and levelling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated

above has been carried out, the voids in the rock filling shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 ton roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

7.B.11 Fill Density

The compaction, where so called for, shall comply with minimum 95% Modified Proctor Density at moisture content differing not more than 4% from the optimum moisture content. The Contractor shall demonstrate adequately by field and laboratory tests that the specified density has been obtained.

7.B.12 Lead

Lead for deposition/disposal of excavated material, shall be as specified in the respective item of work. No extra compensation is admissible on the grounds that the lead including that for borrowed material had to be transported over marshy or 'katcha' land/route.

7.B.13 Measurement and Payment

All excavation shall be measured net. Dimensions for purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, tanks, rafts or other foundations/structures to be built, multiplied by the mean depth from the surface of the ground in accordance with the drawings. Excavations in side slopes will not be paid for. Contractor may make such allowance in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety or excavation. Reasonable working space, beyond concrete dimensions and shuttering where considered necessary in the opinion of Engineer will be allowed in excavation and considered for payment. However, if concreting is proposed against the excavated sides, no such over-excavation will be permitted. In such cases over-excavation shall be made good by Contractor with concrete of the same class as in the foundations at his cost.

Trench excavation for pipelines shall be measured using the dimensions detailed in the standard section shown on the Drawings. Excavation beyond the widths or depths required will not be paid for any additional concrete or bedding material required as a result of over-excavation at the Contractor's expense.

Backfilling as per specification the sides of foundations of columns, footings, structures, walls, tanks, rafts, trenches etc. with excavated material will not be paid for separately. It shall be clearly understood

that the rate quoted for excavation including backfilling shall include stacking of excavated material as directed, excavation/packing of selected stacked material, conveying it to the place of final backfill, compaction etc. as specified. As a rule, material to be backfilled shall be stacked temporarily as directed by the Engineer.

Payment for fill inside trenches, plinth or similar filling with selected excavated material will be made for only compaction as specified/directed. Cost of all other operations shall be deemed to have been covered in the rate quoted for excavation. Payment for this work will be made based on measurement of plinth/trench dimensions, filled. The plinth ground levels shall be surveyed before hand for this purpose. If no compaction is specified/desired such filling will not be separately paid for. In such an event the fill shall be leveled/finished to the profile as directed at no extra cost.

Backfilling, plinth filling etc. with borrowed earth will be paid for at rates quoted. The quoted rate shall include all operations such as clearing, excavation, lead and transport, fill, compaction etc, as specified. Actual quantity of consolidated filling or actual quantity or excavation in the borrow pits (less such top soil which has been excavated and not used for filling) whichever is less shall be measured and paid for in cubic metres. The lead, lift etc. shall be as indicated in the schedule of quantities.

Actual quantity of consolidated sand filling shall be measured and paid in cubic metres.

Volume of rock excavated shall be calculated on the basis of length, breadth and depth of excavation indicated on the drawings. No payment will be made for excavations/over break beyond payment line specified. Where such measurement is not possible as in the case of strata intermixed with soil, excavated rock shall be properly stacked as directed by Engineer and the volume of rock stacked as directed by Engineer and the volume of rock calculated on the basis of stack measurements after making appropriate allowance for voids. The allowance to be made for voids shall be decided by Engineer.

7.B.14 Timber Shoring

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 25 cm x 4 cm sections or as approved by the Engineer. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walings of strong wood at maximum 1.2 metre spacings, strutted with ballies or as approved by the Engineer. The length of the ballie struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards

shall be placed horizontally against each side of the excavation and supported by vertical walings, which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by the Engineer. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc. from collapsing.

Timber shoring may also be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Engineer.

The withdrawal of the timber shall be done carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded with, systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber.

In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm x 4 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacings shall be subject to the approval of the Engineer. In all other respects, the Specifications for close timbering shall apply to open timbering.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut. If however, Engineer directs any timbering to be left-in, keeping in mind the type of construction or any other factor, Contractor shall be paid for at the scheduled item rate for such left-in timbering.

7.B.15 Measurement

Unless otherwise separately provided for in Schedule of Quantities, the actual effective area of shored faces as approved by Engineer shall be measured in sq.m. The area of planking embedded in the bed/sides of excavation will not be considered, nor the area supporting inclined struts in case of large pits/open excavation. All planks, boards, walings, verticals, struts, props and all other

materials required for shoring and subsequent safe dismantling and removal shall be included in the quoted unit rates.

7.B.16 Dewatering

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Engineer, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Engineer to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Engineer. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a buildup of water in the opinion of the Engineer obstructs the progress of the work, leads to insanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Engineer, to be large, a well point system- single stage or multistage, shall be adopted. The Contractor shall submit to the Engineer, details of his well point system including the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval. Unless separately provided for in the Schedule of prices, the cost of dewatering shall be included in the item rate for excavation.

7.B.17 Measurement

Unless separately provided for in the Schedule of quantities, dewatering is deemed to have been included in the unit rates quoted for excavation. If separately provided for, the unit of measurement shall be as indicated in the Schedule of Quantities.

7.B.18 Rain Water Drainage

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Engineer.

7.B.19 Site Filling

Sand fill

Sand fill shall be deposited to bring the grade level to the desired elevation after compaction of fill.

Sandy fill shall be carried out in one of the following methods as specified. Sandy fill shall be compacted where so specified, by 12 tonne vibrating rollers as indicated in specification. The fill material shall be compacted to the specified density, where so specified.

If the density of fill or use of rollers for compaction is not specified, Contractor shall ensure necessary compaction by the passage of trucks, carrying the fill material over the deposited fill in such a way that the entire fill area is covered. This will reasonably compact the sand fill and will be accepted by Engineer. However, Contractor shall ensure that every layer is thus compacted before the succeeding layers are deposited. Each layer shall not exceed 200mm in thickness.

Compaction of sandy fill by flooding the area shall be carried out where so specified. In this case, Contractor should ensure that the fill material is not washed away. This work shall be carried out as directed by Engineer.

Soil fill

Approved soil fill consisting of ordinary soil, moorum, soil containing gravel, shingle, etc. shall be deposited in layers not exceeding 200mm. Contractor should ensure that all clods of earth are broken down to a size not larger than 100mm.

Where density of fill or use of rollers is not specified the fill shall be carried out as specified.

Where specified, the required density to fill shall be obtained by proper compaction.

Measurement

Measurement shall be made on the basis of Clause 6.13.

End of Part 7B

Part 7C CONCRETE AND ALLIED WORKS

7.C.1 Applicable Codes

Materials

1) IS.269 Specification for 33 grade ordinary Portland cement.
2) IS.455 Specification for Portland slag cement.
3) IS.1489 Specification for Portland-pozzolana cement (Part 1 & 2).
4) IS:8112 Specification for 43 grade ordinary Portland cement.
5) IS:12269 Specification for 53 grade ordinary Portland cement.
6) IS:12330 Specification for sulphate resisting Portland cement.
7) IS:383 Specification for coarse and fine aggregates from natural sources for concrete.
8) IS:432 Specification for mild steel and medium (tensile steel bars and hard-drawn steel) wires for concrete reinforcement.

(Part 1 & 2)

9) IS:1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.

10) IS:1566 Specification for hard-drawn steel wire fabric for concrete reinforcement.

11) IS:9103 Specification for admixtures for concrete.

12) IS:2645 Specification for integral cement water-proofing compounds.

13) IS:4990 Specification for plywood for concrete shuttering work.

Material Testing

1) IS.4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)

2) IS:4032 Method for chemical analysis of hydraulic cement.

3) IS:650 Specification for standard sand for testing of cement.

4) IS:2430 Methods for sampling of aggregates for concrete.

5) IS.2386 Methods of test for aggregates for concrete (Parts 1 to 8)

6) IS:3025 Methods of sampling and test (physical and chemical) for water used in industry.

7) IS:6925 Methods of test for determination of water soluble chlorides in concrete admixtures.

Material Storage

1) IS:4082 Recommendations on stacking and storing of construction materials at site.

Concrete Mix Design

1) IS:10262 Recommended guidelines for concrete mix design.

2) SP:23 (S&T) Handbook on Concrete Mixes

Concrete Testing

1) IS.1199 Method of sampling and analysis of concrete.

2) IS:516 Method of test for strength of concrete.

3) IS:9013 Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.

4) IS:8142 Method of test for determining setting time of concrete by penetration resistance.
5) IS:9284 Method of test for abrasion resistance of concrete.
6) IS:2770 Methods of testing bond in reinforced concrete.

Equipments

1) IS:1791 Specification for batch type concrete mixers.
2) IS:2438 Specification for roller pan mixer.
3) IS:4925 Specification for concrete batching and mixing plant.
4) IS:5892 Specification for concrete transit mixer and agitator.
5) IS:7242 Specification for concrete spreaders.
6) IS:2505 General Requirements for concrete vibrators: Immersion type.
7) IS:2506 General Requirements for screed board concrete vibrators.
8) IS:2514 Specification for concrete vibrating tables.
9) IS:3366 Specification for pan vibrators.
10) IS:4656 Specification for form vibrators for concrete.
11) IS:11993 Code of practice for use of screed board concrete vibrators.
12) IS:7251 Specification for concrete finishers.
13) IS:2722 Specification for portable swing weigh batchers for concrete (single and double bucket type).
14) IS:2750 Specification for steel scaffoldings.

Codes Of Practice

1) IS:456 Code of practice for plain and reinforced concrete.
2) IS:457 Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
3) IS:3370 Code of practice for concrete structures for storage of liquids (Parts 1 to 4)
4) IS:3935 Code of practice for composite construction.
5) IS:2204 Code of practice for construction of reinforced concrete shell roof.
6) IS:2210 Criteria for the design of reinforced concrete shell structures and folded plates.

7) IS:2502 Code of practice for bending and fixing of bars for concrete reinforcement.
8) IS:5525 Recommendation for detailing of reinforcement in reinforced concrete works.
9) IS:2751 Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
10) IS:9417 Specification for welding cold worked bars for reinforced concrete construction.
11) IS:3558 Code of practice for use of immersion vibrators for consolidating concrete.
12) IS:3414 Code of practice for design and installation of joints in buildings.
13) IS:4326 Code of practice for earthquake resistant design and construction of building.
14) IS:4014 Code of practice for steel tubular scaffolding (Parts 1 & 2)
15) IS:2571 Code of practice for laying insitu cement concrete flooring.
16) IS:7861 Code of practice for extreme weather concreting : Part 1 Recommended practice for hot weather concreting.

Construction Safety

1) IS.3696 Safety code for scaffolds and ladders. (Parts 1 & 2)
2) IS:7969 Safety code for handling and storage of building materials.
3) IS:8989 Safety code for erection of concrete framed structures.

Measurement

1) IS 1200 Method of measurement of building and Engineering works
2) IS 3385 Code of practice for measurement of Civil Engineering works

7.C.2 General

The Engineer shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment and the quality control system. Such an inspection shall be arranged and the Engineer's approval obtained, prior to starting of concrete work. This shall, however, not relieve the Contractor of any of his responsibilities. All materials which do not conform to the Specifications shall be rejected.

Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/standards shall generally be used. Other materials may be used after approval of the Engineer and after establishing their performance suitability based on previous data, experience or tests.

7.C.3 Materials

Cement

Unless otherwise called for by the Engineer, cement shall be ordinary Portland cement conforming to IS:269, IS:8112 or IS:12269.

Where Portland pozzolana or slag cements are used, it shall be ensured that consistency of quality is maintained, there will be no adverse interactions between the materials and the finish specified is not marred.

Only one type of cement shall be used in any one mix. The source of supply, type or brand of cement within the same structure or portion thereof shall not be changed without approval from the Engineer.

Cement which is not used within 90 days from its date of manufacture shall be tested at a laboratory approved by the Engineer and until the results of such tests are found satisfactory, it shall not be used in any work.

Aggregates (General)

Aggregates shall consist of naturally occurring stones (crushed or uncrushed), gravel and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/ organic impurities/deleterious materials and conform to IS:383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

Aggregates shall be washed and screened before use where necessary or if directed by the Engineer.

Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse effect on strength, durability and finish, including long term effects, on the concrete.

The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2.

The maximum size of coarse aggregate shall be as stated on the drawings but in no case greater than 1/4 of the minimum thickness of the member.

Plums 160 mm and above of a reasonable size may be used in mass concrete fill where directed. Plums shall not constitute more than 20% by volume of the concrete.

Water
Water used for both mixing and curing shall conform to IS:456. Potable waters are generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.

Reinforcement
In general, reinforcement shall conform to HYSD-CRS-500 or equivalent and other reinforcement bars shall conform to IS:432 or IS:1786 and welded wire fabric to IS:1566 as shown or specified on the drawing.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust, or any other substance that will destroy or reduce bond.

Admixtures
Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS:9103 and integral water proofing admixtures to IS:2645.

Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the Engineer. An admixture's suitability and effectiveness shall be verified by trial mixes with the other materials used in the works. If two or more admixtures are to be used simultaneously in the same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedments.

Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts.

When calcium chloride is permitted such as in mass concrete works, it shall be dissolved in water and added to the mixing water by an amount not exceeding 1.5 percent of the weight of the cement in each batch of concrete. The designed concrete mix shall be corrected accordingly.

7.C.4 Wastage

Wastage allowance for cement and steel and higher rolling margin for steel shall be considered in the item rate and no extra payment shall become payable to the Contractor on any account.

7.C.5 Samples and Tests

All materials used for the works shall be tested before use.

Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by the Engineer samples shall also be got tested by the Contractor in a laboratory approved by the Engineer at no extra cost to Employer.

Sampling and testing shall be as per IS:2386 under the supervision of the Engineer.

Water to be used shall be tested to comply with requirements of IS:456.

The Contractor shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed, the admixture shall be got tested at an approved laboratory at no extra cost.

7.C.6 Storing of Materials

All materials shall be stored in a manner so as to prevent its deterioration and contamination which would preclude its use in the works. Requirements of IS:4082 shall be complied with.

The Contractor will have to make his own arrangements for the storage of adequate quantity of cement. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by the Engineer. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt.

Each size of coarse and fine aggregates shall be stacked separately and shall be protected from leaves and contamination with foreign

material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.

The Contractor shall make his own arrangements for storing water at site in tanks to prevent contamination.

The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground/water. Each type and size shall be stacked separately.

7.C.7 Concrete

General
Concrete grade shall be as designated on drawings. In concrete grade M15, M20 etc. the number represents the specified characteristic compressive strength of 150 mm cube at 28 days, expressed in N/sq.mm as per IS:456. Concrete in the works shall be "DESIGN MIX CONCRETE" or "NOMINAL MIX CONCRETE". All concrete works of grade M5, M7.5 and M10 shall be NOMINAL MIX CONCRETE whereas all other grades, M15 and above, shall be DESIGN MIX CONCRETE.

The grades of concrete to be used are noted on the drawings. In addition, the following table shall apply unless specified otherwise.

Structure	**Grade of Concrete**	**Max. Aggregate Size**
1. All Reservoir works	M30	20 mm
2. Pumping Station		
(a) for foundation raft	M25	40 mm
	M25	20 mm
(b) for walls, columns, floor beams, circular floor slab	M20	20 mm
(c) for columns, beams, slabs etc.		
3. Valve chambers and pipe trenches		
(a) for foundation raft	M25	40 mm
(b) walls, columns	M25	20 mm
(c) for slabs, beams, etc.	M20	20 mm
4. Anchor blocks on pipeline, base slab of storm water drain	M15	40 mm
5. Pipeline embankment, grade slab, ramps, footings under walls, SW drain coping etc.	M15	20 mm

Design Mix Concrete

7.C.8 Mix Design & Testing

For Design Mix Concrete, the mix shall be designed according to IS:10262 and SP:23 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS:456. The design mix shall in addition be such that it is cohesive and does not segregate and should result in a dense and durable concrete and also capable of giving the finish as specified. For liquid retaining structures, the mix shall also result in water tight concrete. The Contractor shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

The minimum cement content for Design Mix Concrete shall be as per Appendix-A of IS:456 or as given below, whichever is higher.

Grade of Concrete	Minimum Cement Content in Kg/Cum of Concrete
M15	260
M20	320
M25	340
M30	360

The minimum cement content stipulated above shall be adopted irrespective of whether the Contractor achieves the desired strength with less quantity of cement. The Contractor's quoted rates for concrete shall provide for the above eventuality and nothing extra shall become payable to the Contractor in this account. Even in the case where the quantity of cement required is higher than that specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the Contractor.

The Contractor shall submit details of the source of all material and the proposed quantities of each ingredient per cubic metre of fully compacted concrete. The Contractor shall then make trial mixes for each class of concrete using the same Contractor's Equipment and the same materials as are proposed for the Permanent Works. The Contractor shall give 24 hours notice of such trials to enable the Engineer's Representative to attend. For each trial mix, three separate batches of concrete shall be made by the Contractor and will be tested at 28 days all in accordance with IS : 516. Such trial mixes shall not be the first batch through the plant in any one sequence of concrete production.

The Contractor shall not commence concreting in the Permanent Works until details of trial mixes and test results for each class of concrete have been submitted to and approved by the Engineer.

Unless otherwise specified, only medium graded fine aggregate shall be used.

A trial mix design will be approved by the Engineer with respect to strength if the average compressive strength of the nine cubes so tested is more than the target mean strength appropriate to the grade of concrete.

For concrete of Grade 30 and over the Contractor shall cast two sample wall panels 48 hours apart. Each shall be cast in two equal lifts to form a wall panel having one horizontal construction joint formed in the manner proposed by the Contractor for the Works. The top surface of the second lift shall have a Type U3 finish. The panels shall not be touched up after stripping. The panels shall be 300 mm thick and 1.5 m long by 1.5 m high. The Contractor shall not commence concreting in the Permanent Works until the test panels have been approved by Engineer.

The Contractor shall not alter the approved mix proportions nor the approved source of supply of any of the ingredients without having previously obtained the approval of the Engineer.

During production, the Engineer may require trial mixes to be made before a substantial change is made in the materials or in the proportions of the materials to be used.

It shall be the Contractor's sole responsibility to carry out the mix designs at his own cost. He shall furnish to the Engineer at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS:516 shall comply with the requirements of IS:456 as follows :

Grade of Concrete	**Minimum Compressive Strength N/sq.mm at 7 days**	**Specified Characteristic Compressive Strength N/sq.mm at 28 days**
M 15	10.0	15.0
M 20	13.5	20.0
M 25	17.0	25.0
M 30	20.0	30.0
M 35	23.5	35.0
M 40	27.0	40.0

A range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Engineer is given below :

Structure/Member	**Slump in millimeters**	
	Maximum	**Minimum**
Reinforced foundation walls and footings	75 75	40 40
Plain footings, caissons and substructure walls	100	40
Slabs, Beams and reinforced walls	75	40
Pump & miscellaneous	100	40
Equipment Foundations	50	40
Building columns	50	40
Pavements		
Heavy mass construction		

Note : All concreting done for water retaining structures shall have a minimum slump value of 60 mm and maximum of 100 mm

7.C.9 Batching & Mixing of Concrete

It is expected that batching plants of suitable capacity and pumps for placing concrete shall be used. However, the Contractor shall submit programme of concrete and allied works during the award of contract which will then be reviewed accordingly. Proportions of aggregates and cement, as decided by the concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within one percent of the desired value.

Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for use by the Engineer shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional cement to allow for sticking in the drum.

Arrangement should be made by the Contractor to have the cubes tested in an approved laboratory or in field with prior consent of the Engineer. Sampling and testing of strength and workability of concrete shall be as per IS:1199, IS:516 and IS:456.

Nominal Mix Concrete

7.C.10 Mix Design & Testing

Mix design and preliminary tests are not necessary for Nominal Mix Concrete. However works tests shall be carried out as per IS:456. Proportions for Nominal Mix Concrete and w/c ratio may be adopted as per Table 3 of IS:456. However it will be the Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

7.C.11 Batching & Mixing of Concrete

Based on the adopted nominal mixes, aggregates shall be measured by volume. However cement shall be by weight only, using whole bags of cement.

7.C. 12 Formwork

Formwork shall be all inclusive and shall consist of but not be limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, falsework, wedges etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor. However, if so desired by the Engineer, the drawings and calculations for the design of the formwork shall be submitted to the Engineer for approval.

Formwork shall be designed to fulfill the following requirements :

Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.
Made of suitable materials.
Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.
Capable of withstanding without deflection the worst combination of selfweight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.
Capable of easily striking without shock, disturbance or damage to the concrete.
Soffit forms capable of imparting a camber if required.
Soffit forms and supports capable of being left in position if required.
Capable of being cleaned and/or coated if necessary immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip

form may be used with the approval of the Engineer. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of the Engineer. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left insitu shall not impair the desired appearance or durability of the structure by causing spalling, rust staining or allowing the passage of moisture.

For liquid retaining structures, sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.

All corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size, except where specified in the drawings.

Forms for substructure may be omitted when, in the opinion of the Engineer, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be larger, as approved by the Engineer, than that required as per drawing to compensate for irregularities in excavation.

The Contractor shall provide adequate props carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.0m or as approved by the Engineer. The Contractor shall temporarily and securely fix items to be cast (embedments/ inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

Formwork showing excessive distortion, during any stage of construction, shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at Contractor’s cost.

The striking time for formwork shall be determined based on the following requirements:

Development of adequate concrete strength;
Permissible deflection at time of striking form work;
Curing procedure employed - its efficiency and effectiveness;
Subsequent surface treatment to be done;
Prevention of thermal cracking at re-entrant angles;
Ambient temperatures; and
Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Under normal circumstances (generally where temperatures are above 20^{o}C) forms may be struck after expiry of the time period given in IS:456 unless approved otherwise by the Engineer. For Portland Pozzolana/slag cement the stripping time shall be suitably modified as approved by the Engineer. It is the Contractor's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resist surface damage and any stresses arising during the construction period.

7.C.13 Reinforcement Workmanship

Reinforcing bars supplied bent or in coils shall be straightened cold without damage. No bending shall be done when ambient temperature is below 5^{o}C. Local warming may be permitted if steel is kept below 100^{o} C.

All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by the Engineer.

Re-bending or straightening incorrectly bent bars shall not be done without the approval of the Engineer.

Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by the Engineer prior to concrete placement. Spacers shall be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spilling of the concrete cover.

Binding wire shall be 16 gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

Substitution of reinforcement, laps/splices not shown on drawing shall be subject to Engineer's approval.

7.C.14 Tolerances

Tolerance is a specified permissible variation from lines, grade or dimensions given in drawings. No tolerance specified for horizontal or vertical building lines or footings shall be construed to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

Tolerances for R.C. Buildings

Variation from the Plumb

(i) In the lines and surfaces of columns, piers, walls and in arises 5 mm per 2.5 m or 25 mm, whichever is less.

(ii) For exposed corner columns and other conspicuous lines
In any bay or 5 m maximum - 5 mm
In 10 m or more - 10 mm

Variation from the level or from the grades indicated on the drawings

(i) In slab soffits, ceilings, beam soffits, and in arrises
In 2.5 m - 5 mm
In any bay or 5 m maximum - 10 mm
In 10 m or more - 15 mm

(ii) For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines :
In any bay or 5 m maximum - 5 mm

In 10 m or more - 10 mm

Variation of the linear building lines from established position in plan and related position of columns, wall and partitions :

In any bay or 5 m maximum - 10 mm
In 10 m or more - 20 mm

Variation in the sizes and locations of sleeves, openings in walls and floors – 5 mm except in the case of and for anchor bolts.

Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls
Minus - 5 mm
Plus - 10 mm

Footings

(i) Variation in dimension in plan
Minus - 5 mm
Plus - 50 mm

(ii) Misplacement or eccentricity
2% of footing width in the direction of misplacement but not more than 50 mm

(iii) Reduction in thickness
Minus - 5% of specified thickness subject to a maximum of 50 mm

Variation in steps

(i) In a flight of stairs
Rise - 3 mm
Tread - 5 mm

(ii) In consecutive steps
Rise - 1.5 mm
Tread - 3.0 mm

7.C.15 Tolerances in other structures

All structures

(i) Variation of the construction linear outline from established position in plan
In 5 m - 10 mm
In 10 m or more - 15 mm

(ii) Variations of dimensions to individual structure features from established positions
In 20 m or more - 25 mm
In buried construction - 50 mm

(iii) Variation from plumb, from specified batter or from curved surfaces of all structures

In 2.5 m	-	10 mm
In 5 m	-	15 mm
In 10 m or more	-	25 mm
In buried construction	-	Twice the above amounts

(iv) Variation from level or grade indicated on drawings in slab, beams, soffits, horizontal grooves and visible arrises.

In 2.5 m	-	5 mm
In 7.5 m or more	-	10 mm
In buried construction	-	Twice the above amounts

(v) Variation in cross-sectional dimensions of columns, beams, buttresses, piers and similar members

Minus	-	5 mm
Plus	-	10 mm

(vi) Variation in the thickness of slabs, walls, arch sections and similar members

Minus	-	5 mm
Plus	-	10 mm

Footing for columns, piers, walls, buttresses and similar members

(i) Variation of dimension in plan

Minus	-	10 mm
Plus	-	50 mm

(ii) Misplacement or eccentricity

2% footing width in the direction of misplacement but not more than 50 mm

(iii) Reduction in thickness

5% of specified thickness subject to a maximum of 50 mm.

Tolerance in fixing anchor bolts shall be as follows :

(i) Anchor bolts without sleeves : 1.5 mm in plan

(ii) Anchor bolts with sleeves : 5.0 mm in elevation

- for bolts upto and including 28 mm dia : 5 mm in all directions
- for bolts 32 mm dia and above : 3 mm in all directions

(iii) Embedded parts : 5 mm in all directions

7.C.16 Preparation Prior to Concrete Placement

Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mould oil applied, inserts and reinforcement shall be correctly positioned and securely held, necessary openings, pockets, etc. provided.

All arrangements-formwork, equipment and proposed procedure, shall be approved by the Engineer. Contractor shall maintain separate Pour Card for each pour as per the format enclosed.

7.C.17 Transporting, Placing and Compacting Concrete

Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be rehandled or caused to flow. For locations where direct placement is not possible and in narrow forms the Contractor shall provide suitable drops and "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.0m as stipulated in clause 6.8.

Concrete shall not be placed in flowing water. Under water, concrete shall be placed in position by tremies or by pipeline from the mixer and shall never be allowed to fall freely through the water.

While placing concrete the Contractor shall proceed as specified below and also ensure the following :

Continuously between construction joints and pre- determined abutments.
Without disturbance to forms or reinforcement.
Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.
Without dropping in a manner that could cause segregation or shock.
In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.
Do not place if the workability is such that full compaction cannot be achieved.
Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary.
In supported excavations, withdraw the linings progressively as concrete is placed.
If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.
Ensure that there is no damage or displacement to sheet membranes.
Record the time and location of placing structural concrete.

Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing

segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set.

Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by the Engineer. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as approved by the Engineer. Concrete shall be protected against damage until final acceptance.

7.C.18 Mass Concrete Works

Sequence of pouring for mass concrete works shall be as approved by the Engineer. The Contractor shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

7.C.19 Curing

Curing and protection shall start immediately after the compaction of the concrete to protect it from :

Premature drying out, particularly by solar radiation and wind;
leaching out by rain and flowing water;
rapid cooling during the first few days after placing;
high internal thermal gradients;
low temperature or frost; vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

All concrete, unless approved otherwise by the Engineer, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessain or other absorbent

material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

Where a curing membrane is approved to be used by the Engineer, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. The curing compound to be used shall be approved by the Engineer before use and shall be applied with spraying equipment capable of a smooth, even textured coat.

Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

7.C.20 Construction Joints and Keys

Construction joints will be as shown on the drawing or as approved by the Engineer. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of the Engineer.

Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as approved by the Engineer.

As soon as the exposed concrete has sufficiently hardened, the surface of the joint shall be water jetted or brushed with a stiff brush to expose the larger aggregate without being disturbed. Roughening of the surface by chipping or hacking will not generally be approved. Before placing fresh concrete against a construction joint all loose material shall be removed and the surface sluiced with water until it is perfectly clean, thereafter all ponded water should be removed.

When concreting is to be resumed on a surface which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this, a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

7.C.21 Foundation Bedding

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy areas shall be cleaned out and back filled with either soil-cement mixture, lean concrete or clean sand compacted as approved by the Engineer. The surfaces of absorptive soils shall be moistened.

Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

7.C.22 Finishes

7.C.22.1 General

The formwork for concrete works shall be such as to give the finish as specified. The Contractor shall make good any unavoidable defects as approved consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

7.C.22.2 Surface Finish Type F1

The main requirement is that of dense, well compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surfaces below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper and effective application of waterproofing material specified for use.

7.C.22.3 Surface Finish Type F2

The appearance shall be that of a smooth dense, well- compacted concrete showing the slight marks of well fitted shuttering joints. The Contractor shall make good any blemishes.

7.C.22.4 Surface Finish Type F3

This finish shall give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no discolouration, blemishes, arises, airholes etc. Only lined or coated plywood with very tight joints shall be used to achieve this finish. The panel size shall be uniform and as large as practicable. Any minor blemishes that might occur shall be made good by the Contractor.

7.C.22.5 Unformed Surfaces

Finishes to unformed surfaces of concrete shall be classified as U1, U2, U3, ‘spaded’ or ‘bonded concrete’. Where the class of finish is not specified the concrete shall be finished to Class U1.

Class U1 finish is the first stage for Class U2 and U3 finishes and for a bonded concrete surface. Class U1 finish shall be a levelled and screeded, uniform plain or ridged finish which (unless it is being

converted to Class U2, U3, or bonded concrete) shall not be disturbed in any way after the initial set and during the period of curing, surplus concrete being struck off immediately after compaction.

Where a bonded concrete surface is specified, the laitance shall be removed from the Class U1 finished surface and the aggregate exposed while the concrete is still green.

A spaded finish shall be a surface free from voids and brought to a reasonably uniform appearance by the use of shovels as it is placed in the Works.

Class U2 finish shall be a wood float finish. Floating shall be done after the initial set of the concrete has taken place and the surface has hardened sufficiently. The concrete shall be worked no more than is necessary to produce a uniform surface free from screedmarks.

Class U3 finish shall be a hard smooth steel-trowelled finish. Trowelling shall not commence until the moisture film has disappeared and the concrete has hardened sufficiently to prevent excess laitance from being worked into the surface. The surfaces shall be trowelled under firm pressure and left free from trowel marks.

The addition of dry cement, mortar or water shall not be permitted during any of the above operations.

7.C.22.6 Integral Cement Finish on Concrete Floor

In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screeded off to proper level and tamped with tamper so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the Engineer shall be supplied and used as recommended by the manufacturer.

7.C.23 Repair and Replacement of Unsatisfactory Concrete

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form

bolts etc. shall be inspected by the Engineer who may permit patching of the defective areas or reject the concrete work.

All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the Employer.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the Engineer.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar with approved bonding agent or by applying epoxy. The decision of the Engineer as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approved by the Engineer.

All the form bolt repairs and delayed repairs shall be carried out using a proportion of white cement in repair mix to the approval of the Engineer, so as to match the colour of the surrounding area.

7.C.24 Vacuum Dewatering of Slabs

Where specified, floor slabs either grade or suspended, shall be finished by vacuum dewatering including all operations such as poker vibration, surface vibration, vacuum processing, floating and trowelling as per equipment manufacturers recommendation. The equipment to be used shall be subject to the Engineer’s approval.

7.C.25 Hot Weather Requirements

Concreting during hot weather shall be carried out as per IS:7861 (Part I).

Adequate provisions shall be made to lower concrete temperatures which shall not exceed 33^{o} C at the time of placement of fresh concrete.

Where directed by the Engineer, the Contractor shall spray non-wax based curing compound on unformed concrete surfaces at no extra costs.

7.C.26 Liquid Retaining Structures

The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness.

The minimum level of surface finish for liquid retaining structures shall be Type F2. All such structures shall be hydro-tested.

The Contractor shall make all arrangements for hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.

Any temporary arrangements that may have to be made to ensure stability of the structures shall also be considered to have been taken into account while quoting the rates.

Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the Engineer. All such rectification shall be done by the Contractor to the entire satisfaction of the Employer/Engineer at no extra cost to the Employer.

7.C.27 Testing Concrete Structures for Leakage

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the Engineer, as described below :

In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.

In the case of structures whose external faces are buried and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the water tightness of the structure. The Engineer shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.

Each compartment/segment of the structure shall be tested individually.

For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

7.C.28 Optional Tests

If the Engineer is not satisfied with the results of the tests under Clause 7.C.5 or otherwise considers that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the Specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the Engineer, as per relevant IS Codes. Contractor shall have to pay for these tests.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, the Engineer reserves the right to order the Contractor to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, etc. The Engineer also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at no cost to the Employer.

If the structure is certified as failed by Engineer, the cost of the test and subsequent dismantling/reconstruction shall be borne by the Contractor.

The quoted unit rates/prices of concrete shall be deemed to provide for all tests mentioned above.

7.C.29 Pressure Grouting

Type of grout	:	Neat cement slurry mixed with Anti-wash out admixture
Suggest equipment	:	Diesel Engine / Electrically operated / hand operated pressure grout pump
Operating Pressure	:	Min. 4.0 kg/cm^2
Type of admixture	:	Anti-washout admixture
Dosage of admixture	:	As per manufacturer’s specification
Recommended equipment	:	Grout pump from 1. M/s Surfex India Ltd. Jodhpur

2. M/s. Ashok Engineering Co. Calcutta
3. M/s. Killics India Ltd. Bombay

or any equivalent

Source of Anti-washout : **"Rheomac 404i UM"**

M/s. BASF Construction Chemicals

India Pvt Ltd., Bangalore

"Auramix V200"

M/s. Forsoc Chemicals India Pvt. Ltd

"PAGEL V 14/40 UW"

M/s. Pidilite Industries Ltd.

"ENTOSH"

M/s. Krishna Conchem Pvt.Ltd.
or any equivalent

7.C.30 Inspection

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of Engineer. Materials rejected by Engineer shall be expressly removed from site and shall be replaced by Contractor immediately.

7.C.31 Clean-Up

Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris, scraps of wood, etc. resulting from the work shall be removed and the premises left clean.

7.C.32 Acceptance Criteria

Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

a) properties of constituent materials;
b) characteristic compressive strength;
c) specified mix proportions;
d) minimum cement content;
e) maximum free-water/cement ratio;
f) workability;
g) temperature of fresh concrete;
h) density of fully compacted concrete;

i) cover to embeded steel;
j) curing;
k) tolerances in dimensions;
l) tolerances in levels;
m) durability;
n) surface finishes;
o) special requirements such as;
    i) water tightness
    ii) resistance to aggressive chemicals
    iii) resistance to freezing and thawing
    iv) very high strength
    v) improved fire resistance
    vi) wear resistance
    vii) resistance to early thermal cracking

The Engineer's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the Contractor.

For work not accepted, the Engineer may review and decide whether remedial measures are feasible so as to render the work acceptable. The Engineer shall in that case direct the Contractor to undertake and execute the remedial measures. These shall be expeditiously and effectively implemented by the Contractor. Nothing extra shall become payable to the Contractor by the Employer for executing the remedial measures.

7.C.33 Mode of Measurement and Payment

The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment on account of such items as leaving holes, embedding inserts, etc. shall be entertained unless separately provided for in the Schedule of Quantities. No extra claim shall also be entertained due to change in the number, position and/or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift, lead of scaffolding etc. All these factors should be taken into consideration while quoting the unit rates. Unless provided for in the Schedule of Quantities the rates shall also include fixing inserts in all concrete work, whenever required.

Payments for concrete will be made on the basis of unit rates quoted for the respective items in the Schedule of Quantities. No deduction in the concrete quantity will be made for reinforcements, inserts etc. and opening less than 0.100 of a sq.m. and 0.010 cu.m where concrete is measured in cu.metres. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets, etc. will not be made. Similarly the unit rates for concrete work shall be inclusive or exclusive of shuttering as provided for in the Schedule of Quantities.

Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned upto the underside of slabs/beams.

The unit rate for precast concrete members shall include formwork, mouldings, finishing, hoisting and setting in position including setting mortar, provision of lifting arrangement etc. complete. Reinforcement and inserts shall be measured and paid for separately under respective item rates.

Only the actual quantity of steel embedded in concrete including laps as shown on drawings or as approved by Engineer shall be measured and paid for, irrespective of the level or height at which the work is done. The unit rate for reinforcement shall include all wastages, binding wires, chairs, spacer bars etc. for which no separate payment shall be made.

Where the formwork is paid for separately, it shall be very clearly understood the payment for formwork is inclusive of formwork, shuttering, shoring, propping scaffolding etc. Only the net area of concrete formed(shuttered) shall be measured for payment.

7.C.34 Specification for Anti Corrosive Chemical

Type	:	Zinc based two parts epoxy-phenolic/polyurethane coating suitable for application to ferrous surfaces
Pot life	:	Shall not be less than 6 hrs. at 25°C - 35°C
Consistency	:	Brushable to form a continuous formation
Requirements	:	Shall be applied directly on the prepared surface of ferrous metal to achieve intimate contact with the base metal
Wet film thickness (WFT)	:	135 microns (Min)
Dry film thickness (DFT)	:	40 microns (Min)
Surface preparation	:	Wire brushing / buffing wheel / Solvent free from chlorides or any suitable

		means
Curing	:	45 minutes (air curing)
Source of Anticorrosive Chemical	:	**“Concresive ZRi”** M/s. BASF Construction Chemicals India Pvt. Ltd., Bangalore **“CEMPATC R”** M/s. Don Construction Chemicals India Ltd. **“Dr. Fixit Epoxy Zinc Primer”** M/s.Pidilite Industries Ltd. **“Nito Zinc Primer”** M/s. Fosroc Chemicals (India) Pvt.Ltd. **“Nito Zinc Primer”** M/s. Krishna Conchem Products Pvt.Ltd. **“Colusal MK”+ “Colusal 25”** M/s. MC Bauchemie (India) Pvt. Ltd. **“Sika Top Armatec 108/Friazinc R”** M/s. Sika India Pvt.ltd **Or any equivalent**

7.C.35 Specification for Corrosion Inhibitor

Type	:	Concrete Penetrating corrosion inhibitors
Surface Preparation	:	Surface should be free from oil, laitance, greese, loose particles, etc. by wire brushing/ sand blasting/water jet
Service Condition	:	a. Shall resist carbon di oxide, chloride,sulphate and other dilute acids b. Shall penetrate concrete to min.of

		depth 200mm and resist corrosion of embedded rebars c. Shall be non-toxic and free from nitrate and chromate
Application	:	Brushing / Spray gum
Application dosage	:	2 to 4m^2/l or as per manufacturer specifications
Available sources	:	**"PROTECTOSIL CIT"** M/s. BASF Construction Chemicals India Pvt. Ltd., Bangalore **"Conplast CN"** M/s. Fosroc Chemicals (India) Pvt. Ltd. **Or any equivalent**

7.C.36 Specification for Weld Mesh

Reference	:	Indian Standard Specification IS: 1566-1982 reaffirmed in 2000
Wire diameter	:	3mm
Size of openings	:	50 x 50 x 3mm
Type	:	Spot welded non-galvanized mesh
Ultimate tensile strength of wire	:	3800 kg/cm^2 min
Elongation	:	20 percent min.

7.C.37 Specifications for Polymer Modified Mortar

Type	:	Structural grade polymer modified mortar
Material requirement	:	a. Ready to use / prepared at site polymer modified cementatious powder b. Polymer liquid c. Water conforming to IS:456-2000 d. Acrylic bonding agent e. polypropylene
Mix proportion	:	Mortar shall be prepared as per manufacturers recommendations with 125g of polypropylene fibers as per 50

		kg of dry mortar
Consistency	:	Trowellable Consistency
Surface Preparation	:	Identified concrete surface shall thoroughly roughened by chipping, followed by water jet cleaning
Bonding agent	:	Surface shall be primed with acrylic bonding agent prior to application of mortar
Recommended thickness	:	Not more than 12mm per layer
Curing	:	Air curing
Flexural Strength	:	Not less than 4.5 N/mm^2
Compressive strength	:	Not less than 15 N/mm^2 for 7 days Not less than 25 N/mm^2 for 28 days
Recommended prepared polymer modified mortar	:	**“Emaco S48C T”** M/s. BASF Construction Chemicals India Pvt.Ltd. **“Cempatch HM”** M/s. Don Construction Chemical India Ltd.” **“Dr. Fixit Epoxy Zinc Primer”** M/s.Pidilite Industries Ltd. “Renderoc S2” **M/s Fosroc Chemicals (India) Pvt. Ltd.** “Sika Top 122.HS” **M/s Sika India Pvt., Ltd.** Or any equivalent

7.C.38 Specification for Sand Blasting

Reference	:	Indian Standard Specification IS: 9012-1978 (reaffirmed in 2002)
Type of sand	:	Dry coarse sand confirming to Zone 1 of IS:383-1970 (reaffirmed 2002)

Application pressure	:	At nozzle point – 7 kg/cm^2 to 8 kg/cm^2
		At compressor point – 9 kg/cm^2 to 10 kg/cm^2
Requirement of Hose	:	Confirming to IS:5894-1990
		(31.5mm dia)
Recommended Brand Hose	:	COSMOS
		Indu – Sand Blast
		Dunlop or equivalent
Compressor capacity	:	250 to 300 CFM
Recommended sand blasting equipment	:	a. M/s. Surfex India Ltd., Jodhpur b. M/s. Ashok Engineering Co. Ltd., Calcutta **Or any standard manufacturer**

7.C.39 Specification for Shotcreting

Reference	:	Indian Standard Specification
		IS: 9012-1978 (reaffirmed in 2002)
Material Requirement	:	a. Cement confirming to IS:8112-1989 reaffirmed-2000 b. Fine aggregate confirming to zone II & III IS 383-1970 c. Coarse Aggregate – washed & dust free confirming to IS 383-1970 d. Water – confirming to IS:4456-2000 e. Silica fumes f. Polypropylene fibers g. Super-Plasticizers confirming to IS:9103-1999
Mix proportion	:	1 part of (a)
		+2 Parts of (b)
		+2 parts of ©
		+0.5% max w/c ratio
		+5.0% to 6.0% of (e)
		+125g of (f) per bag of cement
		+ 0.8% to 1.2% of (g)
Surface Preparation	:	Identified concrete surface shall be thoroughly roughened by chipping and followed by sand blasting and water jet

		cleaning
Reinforcement	:	As detailed in the drawing
Application Pressure	:	at Nozzle point not less than 6 kg/cm^2 at compressor point not less than 10 kg/cm^2
Recommended equipment for shotcreting	:	a. Surfex India Limited, Jodhpur b. Ashok Engineering, Kolkata c. Shah & Pandey,Mumbai **or any euivalent**
Recommended Super Plastisizer	:	**"Rheobuild SP1"** M/s. BASF Construction Chemicals India Pvt., Ltd., Bangalore **"Conplast SP 430"** M/s. Forsoc Chemicals India Pvt. Ltd **or any euivalent**
Recommended hose	:	Confirming to IS:5894-1990 (31.5mm dia) Dunlop or equivalent
Compressor Capacity	:	300 CFM min. operated throught diesel or electrical power
Recommended Compressor	:	a. ATLAS CAPCO India Ltd. b. Consolidated Pneumatic India Limited c. C. ELGI India Ltd. d. INGERSOLL-RAND India Ltd. e. CHICAGO PNEUMATIC Ltd. **or any equipment**

7.C.40 Specification for Shear Connectors

Material for connector	:	Deformed rebar (Fe 415)
Diameter of connector	:	As specified in drawing
Diameter of holes to be drilled in concrete	:	As specified in drawing
Depth of embedment	:	As specified in drawing
Cleaning of drilled holes	:	Air and water jet

Anchoring medium	:	a. Quick setting polyester resin anchor grout b. Ready to use epoxy putty
Setting time	:	a. Less than 30 minutes in case of polyester resin grout b. Not more than 24 hours in case of epoxy putty
Suggested commercial anchoring media	:	**"MasterFlow 935"** M/s. BASF India Lts., Bangalore **"Keygrout"** M/s. Don Construction Chemicals India Ltd. **"Dr. Fixit Anchorfix P/S"** M/s. Pidilite Indistries Ltd. **"Lokfix L/P/S"** Overhead & Horizontal – Gun grade M/s. Fosroc Chemicals (India) Pvt. Ltd. **"EP310"** M/s. ARDEX Endura **or any equivalent**
Recommended pull out force	:	500 kg. minimum
Type of equipment for drilling	:	Electrically operated rotary-cum-hammering action drilling machine
Recommended drilling equipment from	:	a. Electrix India Ltd. b. Hitachi Koki India Ltd. c. Hilti India Ltd. d. MICO Bosch Ltd. or any equivalent
Type of drill bits	:	Tungstun Carbide
Recommended brand	:	a. MICO Bosh b. Hilti India Ltd. or any equivalent

7.C.41 Specification for yelahanka Tiles

Machine made flat Yelahanka tiles shall be of the size and thickness as specified in the item of work. Tiles shall be soaked in water for at least one hour before laying. The tiles shall be laid on a mortar bed of cement mortar 1:3 with an average thickness of 25mm. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and to set

to plane surface true to slope, using trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally at right angles to the direction on run-off gradient. Transverse joints in alternate rows shall come directly in line with each other. Transverse joints in adjacent courses shall break joints by at least 50 mm. The joints shall be completely filled and flush pointed with cement mortar 1:3 mixed with red-oxide. Curing shall be carried out for a minimum period of seven days.

End of Part 7C

STRUCTURAL STEEL WORK

7.D.1 Applicable Codes and Specifications

The supply, fabrication, erection and painting of structural steel works shall comply with the following specifications, standards and codes unless otherwise specified herein. All standards, specifications and

codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

IS : 808 Dimensions for Hot Rolled Steel sections

IS : 814 Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel

IS : 800 Code of Practice for General Construction in Steel

IS : 801 Code of Practice for Use of Cold Formed Light Gauge Steel Structural Members in General Building Construction

IS : 806 Code of Practice for Use of Steel Tubes in General Building Construction

IS : 7205 Safety Code for Erection of Structural Steel Work

IS : 7215 Tolerances for Fabrication of Steel Structures

AISC Specifications for Design, Fabrication and Erection of Buildings

IS : 1161 Steel Tubes for structural purposes

IS:102 Ready Mixed paint, Brushing, Red Lead, Non-setting, Priming.

IS:110 Ready Mixed paint, brushing, grey filler for enamels for use over primers.

IS:117 Ready Mixed paint, Brushing, Finishing, Exterior Semigloss for general purposes, to Indian Standard colours.

IS:158 Ready Mixed paint, Brushing, Bituminous, Black, Lead free, Acid, Alkali and heat resisting.

IS:159 Ready Mixed paint, Brushing, Acid resisting for protection against acid fumes, colour as required.

IS:341 Black Japan, Types A, B and C

IS:2339 Aluminium paint for general purposes, in Dual container

IS:2932 Specification for enamel, synthetic, exterior, type 1, (a) undercoating, (b) finishing

IS:2933 Specification for enamel, exterior, type 2, (a)

undercoating, (b) finishing

IS:5905	Sprayed aluminium and zinc coatings on Iron and Steel.
IS:9862	Specification for ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water & chlorine resisting.
IS:13183	Aluminium paint, Heat resistant.
IS : 1239	Mild steel tubes, tubulars and other Wrought steel fittings Part 1 – Mild steel tubes Part 2 – Mild steel tubulars and other wrought steel pipe fittings
IS : 1363 (Parts 1 to 3)	Hexagon Head Bolts, Screws and Nuts of product Grade C (Size range M5 to M64)
IS : 1367 (All parts)	Technical Supply Conditions for Threaded Fasteners
IS : 1977	Structural Steel (Ordinary Quality)
IS : 2062	Steel for General Structural Purposes
IS : 2074	Ready Mixed Paint, Air drying, Red Oxide Zinc Chrome and Priming
IS : 3502	Steel Chequered Plate
IS : 5369	General Requirements for Plain Washers and Lock Washers
IS : 816	Code of Practice for use of Metal Arc Welding for General construction in Mild Steel
IS : 822	Code of Procedure for Inspection of Welds
IS : 1200	Method of Measurement in Building Civil Works
IS : 1477	Code of Practice for Painting of (Parts 1&2) Ferrous

Metals in Buildings

IS : 3658 Code of Practice for Liquid Penetrant Flaw Detection

IS : 5334 Code of Practice for Magnetic Particle Flaw Detection of Welds

IS : 9595 Recommendations for Metal Arc Welding of Carbon and Carbon Manganese Steel

IS : 1367 Technical, Supply, Conditions for steel (Part 13) threaded fasteners

IS : 1573 Electroplated Coating of Zinc on Iron and Steel

IS : 2629 Recommended Practice for Hot Dip Galvanising of Iron and Steel

IS : 2633 Method of Testing Uniformity of Coating on Zinc Coated Articles

IS : 4736 Hot Dip Zinc coating on Mild steel tubes

IS : 4759 Hot Dip Zinc coating on Structural Steel and other Allied products

IS : 5905 Sprayed Aluminium and Zinc Coatings on Iron and Steel

IS : 6158 Recommended Practice for Safeguarding against Embrittlement of Hot Dip Galvanised Iron and Steel

IS : 6159 Recommended Practice for Design and preparation of Material Prior to Galvanising

IS : 6745 Methods for Determination of Weight of Zinc Coating on Zinc coated Iron and Steel Articles

7.D.2 Steel Materials

Steel materials shall comply with the specifications referred to in Sub-Clause 8.1.
All materials used shall be new, unused and free from defects.

Steel conforming to IS:1977 shall be used only for the following :

Fe310-0(St 32-0)	For general purposes such as door/window frames, grills, steel gates, handrails, fence posts,

	tee bars and other non-structural use.
Fe410-0(St 42-0)	For structures not subjected to dynamic loading other than wind loads such as : Platform roofs, foot over bridges, building, factory sheds etc.
Fe10-0(St 42-0)	Grade steel shall not be used

a) If welding is to be employed for fabrication
b) If site is in severe earthquake zone
c) If plastic theory of design is used

7.D.3 Drawings prepared by the Employer

Design drawings will be furnished to the Contractor and all drawings so furnished shall form a part of this specification. These design drawings prepared by the Engineer will show all the levels, forces on members where necessary, size and orientation of each member, location/size of openings to enable the Contractor to prepare drawings for fabrication and erection. It shall be clearly understood that these drawings are not intended to show connection details, thickness of members, cuts, notches, bends and such other details.

The Engineer reserves the right to make changes. Revisions to drawings, even after release for preparation of shop drawings, are very likely to be made to reflect additional data/details received and updated requirements. Revisions to drawings and any new drawings made to include additional work by the Contractor shall be considered a part of this specification and contract. The Employer shall not entertain any extra claims on this account.

Where the fabrication drawings are to be furnished by the Engineer, he will issue to the Contractor the required copies of such drawings in the sequence required for the fabrication of the components in the order they will be required to be erected at site. Such drawings will be issued in such numbers as required for the Contractor to adhere to the project schedule.

Should the Contractor during the execution of his work, find discrepancies in the information furnished by the Engineer, he shall refer such discrepancies to the Engineer before proceeding with such work.

7.D.4 Drawings prepared by the Contractor

The Contractor shall prepare all fabrication and erection drawings for the entire work. All the drawings for the entire work shall be prepared in metric units. The drawings shall preferably be of one

standard size and the details shown wherein shall be clear and legible.

The Contractor shall not commence detailing unless Engineer's design drawings are officially released for preparation of shop drawings. The Contractor shall be responsible for the correctness of all fabrication drawings. Fabrication drawings shall be revised by the Contractor to reflect all revisions in design drawings as and when such revisions are made by the Engineer.

All fabrication drawings shall be submitted to the Engineer for approval.

No fabrication drawings will be accepted for Engineer's approval unless checked and approved by the Contractor's qualified structural engineer and accompanied by an erection plan showing the location of all pieces detailed. The Contractor shall ensure that connections are detailed to obtain ease in erection of structures and in making field connections.

Fabrication shall be started by the Contractor only after Engineer's approval of fabrication drawings. Approval by the Engineer of any of the drawings shall not relieve the Contractor from the responsibility for correctness of engineering and design of connections, workmanship, fit of parts, details, material, errors or omissions of any and all work shown thereon. The Engineer's approval shall constitute approval of the size of members, dimensions and general arrangement but shall not constitute approval of the connections between members and other details.
The drawings prepared by the Contractor and all subsequent revisions etc. shall be at the cost of the Contractor for which no separate payment will be made.

7.D.5 Fabrication

General

All workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined/ground smooth true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Unless otherwise approved by the Engineer, reference may be made to relevant IS codes for providing standard fabrication tolerance. Material at the shops shall be kept clean and protected from weather.

Connections

Shop/field connections shall be as per approved fabrication drawings.

In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. The length of the bolt shall be such that at least one thread of the bolt projects beyond the nut.

In all cases where bearing is critical, the unthreaded portion of bolt shall bear on the members assembled. A washer of adequate thickness may be provided to exclude the threads from the bearing thickness, if a longer grip bolt has to be used for this purpose.

All connections and splices shall be designed for full strength of members or loads. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

All bolts, nuts, washers, electrodes, screws etc., shall be supplied/brought to site 10% in excess of the requirement in each category and size. Rates shall cover the cost of this extra quantity.

All members likely to collect rain water shall have drain holes provided.

Straightening

All materials, shall be straight and, if necessary, before being worked shall be straightened and/or flattened by pressure and shall be free from twists. Heating or forging shall not be resorted to without the prior approval of the Engineer in writing.

Welding

Welding procedure shall be submitted to the Engineer for approval. Welding shall be entrusted to qualified and experienced welders who shall be tested periodically and graded as per IS 817, IS : 7310 (Part 1) and IS : 7318 (Part 1).

Approval of the welding procedure by the Engineer shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

No welding shall be done when the surface of the members is wet nor during periods of high wind.

Each layer of a multiple layer weld except root and surfaces runs may be moderately peened with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

No welding shall be done on base metal at a temperature below –5 Deg.C. Base metal shall be preheated to the temperature as per relevant IS codes.

Electrodes other than low-hydrogen electrodes shall not be permitted for thicknesses of 32 mm and above.

All welds shall be inspected for flaws by any of the methods described under Sub-clause 8.8.3. The choice of the method adopted shall be agreed with the Engineer.

The correction of defective welds shall be carried out in a manner approved by the Engineer without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means approved by the Engineer shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. The cost of all such tests and operations incidental to correction shall be borne by the Contractor.

7.D.6 Tolerances

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS : 1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerances for fabrication of structural steel shall be as per IS : 7215.

Cutting, punching, drilling, welding and fabrication tolerances shall be generally as per relevant IS codes.

7.D.7 End Milling

Where compression joints are specified to be designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment.

7.D.8 Inspection

General

The Contractor shall give due notice to the Engineer in advance of the works being made ready for inspection. All rejected material shall be promptly removed from the shop and replaced with new material for the Engineer’s inspection. The fact that certain material has been accepted at the Contractor’s shop shall not invalidate final rejection at site by the Engineer if it fails to conform to the requirements of these specifications, to be in proper condition or has fabrication inaccuracies which prevent proper assembly nor shall it invalidate

any claim which the Employer may make because of defective or unsatisfactory materials and/or workmanship.

No materials shall be painted or despatched to site without inspection and approval by the Engineer unless such inspection is waived in writing by the Engineer.

The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified.

For fabrication work carried out in the field the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the Engineer.

Inspection and tests on structural steel members shall be as set forth below.

Material Testing

If mill test reports are not available for any steel materials the same shall be tested by the Contractor to the Engineer's satisfaction to demonstrate conformity with the relevant specification.

Tests on Welds

7.D.8 Magnetic Particle Test

Where welds are examined by magnetic particle testing, such testing shall be carried out in accordance with relevant IS codes. If heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and retested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the permission of the Engineer.

7.D.9 Liquid Penetrant Inspection

In the case of welds examined by Liquid Penetrant Inspection, such tests shall be carried out in accordance with relevant IS Code. All defects shown shall be repaired and rechecked.

Dimensions, Workmanship & Cleanliness

Members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment, surface finish and painting are in accordance with the requirements shown in the Contractor's approved fabrication drawings.

Test Failure

In the event of failure of any member to satisfy inspection or test requirement, the Contractor shall notify the Engineer. The Contractor must obtain permission from the Engineer before any repair `is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the Engineer.

The Engineer has the right to specify additional testing as he deems necessary and the additional cost of such testing shall be borne by the Employer, only in case of successful testing.

The Contractor shall maintain records of all inspection and testing which shall be made available to the Engineer.

7.D.10 Drilling Holes for other works

As a part of this Contract, holes in members required for installing equipment or steel furnished by other manufacturers or other contractors shall be drilled by the Contractor at no extra cost of the Employer. The information for such extra holes will be supplied by the Employer/Engineer.

7.D.11 Marking of Members

After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it.

7.D.12 Errors

Any error in shop fabrication which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the Engineer as defective workmanship. Where the Engineer rejects such material or defective workmanship, the same shall be replaced by materials and workmanship conforming to the Specifications by the Contractor, at no cost to the Employer.

7.D.13 Site Operations

The Contractor shall complete all preliminary works at site well before the arrival of structural steel, such as establishment of a well-equipped and adequately staffed site office, stores, electrical and water connections, electrical winches, derricks, compressors, all tools and tackles, rivet guns, welding sets, torque wrenches, staging, etc., as well as experienced erection and supervisory personnel as part of this contract and any other work that may be necessary so as to start

erection immediately after the arrival of the first batch of steel on site.

The Contractor shall furnish at his own expense, the necessary non-inflammable staging and hoisting materials or equipment required for the erection work and shall remove and take them away after completion of the job. The Contractor shall also provide necessary passageways, fences, safety belts, helmets, lights and other fittings to the satisfaction of the Engineer and to meet the rules of local authorities and for protection to his men and materials. A licensed electrician shall be kept on the job for the entire duration of the work to maintain the Contractor's electrical equipment and connections.

The Contractor shall protect all existing plant, structures, piping, conduits, equipment and facilities against damage during erection. Any damage caused by contractor shall be rectified entirely at his cost, to the satisfaction of the Engineer. If work has to be carried out adjacent to existing switch yards or electrical installations which are live, the Contractor must ensure suitable safety precautions in consultation with Engineer.

If a portion of the work of the project area cannot be made available to the Contractor for his activities due to operations being carried out by other agencies, he shall suitably modify his sequence of operations so as to continue work without interruption. The Contractor shall work in co-ordination with other agencies working on the project site and plan his work suitably so as not to hinder the progress of construction at site.

7.D.14 Acceptance of Steel, its Handling & Storage

The Contractor shall carefully check the steel to be erected at the time of acceptance. Any fabrication defects observed should be brought to the notice of the Engineer.

No dragging of steel shall be permitted. All steel shall be stored 300mm above ground on suitable packing to avoid damage. It shall be stored in the order required for erection, with erection marks visible. All storage areas shall be prepared and maintained by the Contractor. Steel shall not be stored in the vicinity of areas where excavation or grading will be done and, if so stored temporarily, this shall be removed by the Contractor well before such excavation and/or grading commences to a safe distance to avoid burial under debris.

Scratched or abraded steel shall be given a coat of primer in accordance with the Specifications for protection after unloading and handling prior to erection. All milled and machined surfaces shall be properly protected from rust/corrosion by suitable coating and also from damage.

7.D.15 Anchor Bolts & Foundations

The Contractor shall carefully check the location and layout of anchor bolts embedded in foundations constructed, to ensure that the structures can be properly erected as shown on the drawings. Any discrepancy in the anchor bolts/foundation shall be reported to the Engineer. A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by the Contractor at no extra cost. Where beams bear in pockets or on walls, bearing plates shall be set and levelled as part of the work. All grouting under column base plates or beam bearing plates will be carried out by the Contractor.

7.D.16 Assembly & connections

Field connections may be effected either by riveting, bolting, welding or as specified and as shown on the drawings. All field connection work shall be carried out in accordance with specifications. All bolts, nuts, washers, rivets, electrodes required for field connections shall be supplied by the Contractor free of cost. All assembling shall be carried on a level platform. Corrections of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets shall be considered as a part of erection. Any error in the shop, which prevents proper fit on a moderate amount of reaming and slight chipping or cutting, shall be immediately reported to the Engineer.

7.D.17 Erection

All structural steel shall be erected as shown on the drawings prepared by the Contractor and approved by the Engineer. Proper size steel cable slings, etc., shall be used for hoisting. Guys shall not be anchored to existing structures, foundations, etc., unless so permitted by the Engineer in writing. Care shall be taken to see that ropes in use are always in good condition. Structural steel frames shall be erected plumb and true. Temporary bracings shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment and the operation thereof. Such bracings shall be left in place as long as may be required for safety and stability.

Chequered plates shall be fixed to supporting members by tack welding or by countersunk bolts as shown/specified in relevant drawings and/or as approved by the Engineer. The edges shall be made smooth and no burrs or jagged ends shall be left. While splicing, care should be taken so that there is continuity in pattern between the two portions. Care should also be taken to avoid distortion of the plate while welding. The erection of chequered plates shall include:

(a) Welding of stiffening angles/vertical stiffening ribs
(b) Cutting to size and making holes to required shape wherever necessary to allow service piping and/or cables to pass through
(c) Splicing as shown in relevant drawings
(d) Smoothening of edges
(e) Fixing of chequered plates by tack welding or by countersunk bolts
(f) Providing lifting hooks for ease of lifting.

As erection progresses, the work shall be securely bolted to take care of all dead load, wind, seismic and erection stresses. No riveting or welding or final bolting shall be done until the structure has been properly aligned and approved by the Engineer. No cutting, heating or enlarging of the holes shall be carried out without the prior written approval of the Engineer.

7.D.18 Inspection

The Engineer shall have free access to all parts of the job during erection and all erection shall be subjected to his approval. In case of faulty erection, all dismantling and re-erection required will be at the Contractor’s cost. No paint shall be applied to rivet heads or field welds or bolts until these have been approved by the Engineer.

7.D.19 Tolerances

Tolerances mentioned in the relevant codes of practice shall be achieved after the entire structure or part thereof is in line, level and plumb.

7.D.20 Clean up of Work site

During erection, the Contractor shall at all times keep the working and storage areas used by him free from accumulation of waste materials or rubbish. Before completion of erection, he shall remove or dispose of in a satisfactory manner all temporary structures, waste and debris and leave the premises in a condition satisfactory to the Engineer.

7.D.21 Painting

Surface Treatment

All the surfaces of steel work to be painted shall be thoroughly cleaned of all loose mill scale, rust, grease, dirt and other foreign matter. The workmanship shall generally conform to the requirements of IS 1477- Part I.

Oil and grease removal shall be carried out either by solvent cleaning or by using alkali type degreasing agents. The procedure for cleaning shall be as per manufacturer's instructions.

Loose mill scale, loose rust and loose paint shall be removed by wire brushing, scrapping, chipping, rubbing with abrasive paper or steel wool. This method shall not be employed when the surface has firmly adhering mill scale. After hand tool cleaning, the surface shall be rubbed with sand paper so as to ensure that no loose material exists and the surfaces shall be dusted off.

Materials

Primer paint

Anti-corrosive primers shall be either lead based or lead free types. Red lead primer shall conform to IS 102 and red oxide zinc chrome primer shall conform to IS 2074.

Finish Paint

All the materials shall be of the best quality from an approved manufacturer. The Contractor shall obtain prior approval of the Engineer for the brand of manufacture and the colour/shade prior to procurement for usage in the works.

Primer and finish paints shall be compatible with each other to avoid cracking and wrinkling and shall be from the same manufacturer for each painting system.

The colour and shade shall be conforming to IS Standards referred to in Appendix 'D' of IS 1477-Part II. To facilitate choosing the correct shade number from the alternatives available, the Contractor shall adopt trial painting in small patches in consultation with and as approved by the Engineer.

Paints shall be stirred thoroughly to keep the pigment in suspension.

Workmanship

The type and the number of coats of the primer paint and finish paint shall be as specified in the respective items of works. Painting shall be carried out only on thoroughly dry surfaces. No painting shall be

done in frosty/foggy weather or when the humidity is high enough to cause condensation on the surface to be painted. Paint shall not be applied when the temperature of the surface to be painted is at 5deg.C or lower. Primers shall adhere to the surface firmly and offer a key to the subsequent coats. Workmanship shall generally conform to requirements specified in IS:1477-Part II. It is essential to ensure that immediately after preparation of the surfaces, the first coat of primer paint shall be applied by brushing and working it well to ensure a continuous film. After the first coat becomes hard dry a second coat of primer shall be applied by brushing. The dry film thickness of each coat of primer shall not be less than 25 microns.

Application of finishing paints shall be carried out within the shortest possible time interval after primer since the primer coats are too thin to give adequate corrosion protection of the steel surface over a long duration.

Painting shall be carried out either by brushing or by spraying. The Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer.

After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of paint of optimum thickness shall be applied by brushing/spraying with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

The first finishing coat of paint shall be applied by brushing or by spraying and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing or by spraying.

At least 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and shall be approved by the Engineer, prior to applying the next coat.

Minimum dry film thickness of each coat of finish paint of synthetic enamel shall be 25 microns. Minimum dry film thickness of other finish paints shall be as specified in the respective item of work.

7.D.22 Method of Measurement

For the purpose of payment, the weight of the actual, completed structures shall be calculated from the approved drawings for different items of work. Contractor shall submit to Employer relevant material list containing weight of each item.

No allowance will be permitted for weights of rivets, bolts, washers, screws etc. in calculating the weight of the completed structure. No allowances will be permitted for galvanizing, welding or for rolling margins. One tonne for the purpose of payment shall mean One Metric Tonne i.e. 1000 kg.

The weight of a member made out of standard rolled sections such as beams, channels, angles, etc. shall be based on the weight of the member given in IS 808, without deducting for hole, notches, bevel cuts, etc. Where a component consists of a cut joist or channel, the full weight of the rolled section shall be considered only if more than half the depth of the section is used. Otherwise only half the section unit weight shall be taken. Deductions shall be made in the weight of gussets/plates including chequered plates for skew cuts, notches and openings of 900 sq.cm. or larger.

For gussets/plates used in trusses, bracings, columns, beams etc. the area shall be that of the minimum circumscribing rectangle, except as stated above.

The weight of any built-up member shall be separated into the weight of each component.

Erection bolts installed by erector may be left in position on completion of erection; however, no additional payment shall be made either for supply or use of such bolts. If erection bolts are removed after erection is complete, holes shall be plug welded and ground smooth. No extra payment shall be made for such plug welding.

Painting work shall not be measured separately, if primer painting and/or primer and finish painting is deemed to be included in the scope of the item of work of fabrication and erection of structural steel since the rate per tonne of steel is deemed to include for painting as specified.

In cases where primer and/or finish painting work as specified is carried out on erected structural steel executed by a different agency, the method of measurement for painting shall be on the basis of tonnage of steel erected. For this purpose, the tonnage of erected steel as certified for payment to the different agency shall be considered as the basis and no measurement will be carried out separately.

End of Part 7D

GENERAL BUILDING WORKS

7.E.1 Applicable Codes and Specifications

The following codes and standards are included in this section.

IS:110 - Ready mixed paint, brushing, grey filler, for enamels for use over primers
IS:269 - Specification for 33 grade ordinary Portland cement
IS:280 - Specification for mild steel wire for general engineering purposes
IS:287 - Recommendations for maximum permissible moisture content of timber used for different purposes
IS : 304 - High Tensil

IS:337 - Varnish, finishing interior
IS:348 - French polish
IS:383 - Specification for coarse and fine aggregates from natural sources for concrete
IS:412 - Expanded metal steel sheets for general purposes
IS:419 - Specification for putty for use on window frames
IS:428 - Distemper, oil emulsion, colour as required
IS:459 - Specification for unreinforced corrugated and semi-corrugated asbestos cement sheets

IS:702 - Specification for industrial bitumen

IS:710 - Specification for marine plywood
IS:712 - Specification for building limes
IS:730 - Specification for hook bolts for corrugated sheet roofing
IS:733 - Wrought aluminium and aluminium alloys, bars, rods and sections for general engineering purposes
IS:777 - Specification for glazed earthenware tiles
IS:1003 - Specification for timber panelled and glazed shutters (Parts 1 & 2)
IS:1038 - Specification for steel doors, windows and ventilators
IS:1077 - Specification for common burnt clay building bricks
IS:1081 - Code of practice for fixing and glazing of metal (steel & aluminium) doors, windows and ventilators
IS:1124 - Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones
IS:1237 - Specification for cement concrete flooring tiles
IS:1322 - Bitumen felts for water proofing and damp proofing
IS:1346 - Code of practice for water proofing of roofs with bitumen felts
IS:1361 - Specification for steel windows for industrial buildings
IS:1397 - Specification for kraft paper
IS:1443 - Code of practice for laying and finishing of cement concrete flooring tiles
IS:1477 - Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
IS:1542 - Specification for sand for plaster
IS:1580 - Specification for bituminous compounds for water-proofing and caulking purposes
IS:1597 - Code of practice for construction of stone masonry : Part 1 Rubble stone masonry
IS:1659 - Specification for block boards
IS:1661 - Code of practice for application of cement and cement-lime plaster finishes
IS:1834 - Specification for hot applied sealing compound for joint in concrete
IS:1838 - Specification for preformed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type) : Part 1 Bitumen impregnated fibre
IS:1948 - Specification for aluminium doors, windows and ventilators
IS:1949 - Specification for aluminium windows for industrial buildings
IS:2074 - Ready mixed paint, air drying, red oxide- zinc chrome, priming
IS:2098 - Asbestos cement building boards
IS:2114 - Code of practice for laying in-situ terrazzo floor finish

IS:2116 - Specification for sand for masonry mortars
IS:2185 - Specification for concrete masonry units (Parts 1,2 & 3)
IS:2202 - Specification for wooden flush door shutters (Solid core type) : Parts 1 & 2
IS:2212 - Code of practice for brickwork
IS:2250 - Code of practice for preparation and use of masonry mortars
IS:2338 - Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
IS:2339 - Aluminium paint for general purposes, in dual container
IS:2395 - Code of practice for painting concrete, masonry and plaster surfaces (Parts 1 & 2)
IS:2402 - Code of practice for external rendered finishes
IS:2571 - Code of practice for laying in-situ cement concrete flooring
IS:2572 - Code of practice for construction of hollow concrete block masonry
IS:2645 - Specification of integral cement waterproofing compounds
IS:2690 - Specification for burnt clay flat terracing tiles : Part 1 Machine made
IS:2691 - Specification for burnt clay facing bricks
IS:2750 - Specification for steel scaffoldings
IS:2835 - Flat transparent sheet glass
IS:2932 - Specification for enamel, synthetic, exterior type (a) undercoating, (b) finishing
IS:3007 - Code of practice for laying of asbestos cement sheets - corrugated and (Part 1 & 2) semi-corrugated sheets

IS:3036 - Code of practice for laying lime concrete for a water-proofed roof finish
IS:3067 - Code of practice of general design details and preparatory work for damp-proofing and water-proofing of buildings
IS:3068 - Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete
IS:3384 - Specification for bitumen primer for use in water-proofing and damp-proofing
IS:3461 - Specification for PVC-asbestos floor tiles

IS:3462 - Specification for unbacked flexible PVC flooring
IS:3495 - Method of test for burnt clay building bricks: Part 1 to 4
IS:3536 - Specification for ready mixed paint, brushing, wood primer, pink
IS:3564 - Specification for door closers (hydraulically regulated)
- Specification for fire checks doors : Part –I Plate metal covered and rolling type

		Specification for metallic and non-metallic fire check doors : Part-2 Resistance test and performance criteria
IS:3696	-	Safety code of scaffolds and ladders (Parts 1 & 2)
IS:4020	-	Methods of test for wooden flush door : Type test
IS:4021	-	Specification for timber door, window and ventilator frames
IS:4351	-	Specification for steel door frames
IS:4443	-	Code of practice for use of resin type chemical resistant mortars
IS:4457	-	Specification for ceramic unglazed vitreous acid resisting tile
IS:4631	-	Code of practice for laying epoxy resin floor toppings
IS:4832	-	Specification for chemical resistant mortars (Part II)
IS:4860	-	Specification for acid resistant bricks
IS:4948	-	Specification for welded steel wire fabric for general use
IS:5318	-	Code of practice for laying of flexible PVC sheet and tile flooring
IS:5410	-	Cement paint, colour as required
IS:5411	-	Specification for plastic emulsion paint (Parts 1 & 2)
IS:5437	-	Wired and figured glass
IS:5491	-	Code of practice for laying of in-situ granolithic concrete floor topping
IS:6041	-	Code of practice construction of autoclaved cellular concrete block masonry
IS:6042	-	Code of practice for construction of light weight concrete block masonry
IS:6248	-	Specification for metal rolling shutters and rolling grilles
IS:7193	-	Specification for glass fibre base coal tar pitch and bitumen felts
IS:7452	-	Specification for hot rolled steel sections for doors, windows and ventilators
IS:8042	-	Specification for white Portland cement
IS:8543	-	Methods of testing plastics
IS:8869	-	Specification for washers for corrugated sheet roofing
IS:9197	-	Specification for epoxy resin, hardeners and epoxy resin composites for floor topping
IS:9862	-	Specification for ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and chlorine resisting
IS:12200	-	Code of practice for provision of waterstops at transverse contraction joints in masonry and concrete dams
BS	: -	Methods for determination of the fire resistance of

476 (Part – 20)		elements of construction (General Principles)
BS 476 (Part – 21)	: -	Methods for determination of the fire resistance of load bearing elements of construction
BS 476 (Part – 22)	: -	Methods for determination of the fire resistance of non-load bearing elements of construction
Part – IV Fire Protection	-	National Building code of India

7.E.2 Brickwork

Materials

Bricks used in the works shall conform to the requirements laid down in IS: 1077. The class of the bricks shall be as specifically indicated in the respective items of work.

The nominal size of the modular brick shall be 200mmx100mmx100mm with the permissible tolerances over the actual size of 190mmx90mmx90mm as per IS: 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230 mmx115mmx75mm with tolerance upto ±3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.

Bricks shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, hand/machine moulded, deep red, cherry or copper coloured, of regular shape and size & shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand moulded bricks shall be moulded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 5N/sq.mm unless otherwise specified in the items of work.

The average water absorption shall not be more than 20 percent by weight upto class 12.5 and 15 percent by weight for higher classes. Bricks which do not conform to this requirement shall be rejected. Over or under burnt bricks are not acceptable for use in the works.

Sample bricks shall be submitted to the Engineer for approval and bricks supplied shall conform to approved samples. If demanded by Engineer, brick samples shall be got tested as per IS: 3495 by Contractor. Bricks rejected by Engineer shall be removed from the site of works within 24 hours.

Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS: 2250. Mix shall be in the proportion of 1:5 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work . Sand for masonry mortar shall conform to IS:2116. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by Engineer. If so directed by the Engineer, sand shall be screened and washed till it satisfies the limits of deleterious materials.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Mixing shall be done thoroughly in a mechanical mixer, unless hand mixing is specifically permitted by the Engineer. The mortar thus mixed shall be used as soon as possible, preferably within 30 minutes from the time water is added to cement. Incase, the mortar has stiffened due to evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and shall be removed forthwith from the site. Droppings of mortar shall not be re-used under any circumstances.

The Contractor shall arrange for test on mortar samples if so directed by the Engineer.

Workmanship

Workmanship of brick work shall conform to IS: 2212. All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work. Brick work 200mm/230mm thick and over shall be laid in English Bond unless otherwise specified. 100mm/115mm thick brickwork shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be slightly pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilised only to make up required wall length or for bonding. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. In case of one brick thick or half brick thick wall, at least one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45 deg. But in no case the level difference between adjoining walls shall exceed one metre. Brick work shall not be raised more than one metre per day.

Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 10mm/15mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/ pointing respectively to be done later. When plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top.

During inclement weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.

Brickwork shall be kept constantly moist on all the faces for at least seven days after 24 hrs of laying. The arrangement for curing shall be got approved from the Engineer.

Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS:2750 and IS:3696 (Part I). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the Engineer. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for

supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/pointing.

In the event of usage of traditional bricks of size 230 mm x115mm x75mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/floor slabs and at the top of the parapet shall be laid with bricks on edge.

All brickwork shall be built tightly against columns, floor slabs or other structural members.

To overcome the possibility of development of cracks in the brick masonry following measures shall be adopted.

For resting RCC slabs, the bearing surface of masonry wall shall be finished on top with 12 mm thick cement mortar 1:3 and provided with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

RCC/ steel beams resting on masonry wall shall be provided with reinforced concrete bed blocks of 50 mm thickness, projecting 50mm on either sides of the beam, duly finished on top with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.

Steel wire fabric shall be provided at the junction of brick masonry and concrete before taking up plastering work.

Bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting against either a deshuttered slab or beam shall be built only after any proposed masonry wall above the structural member is executed to cater for the deflection of the structural element.

Reinforced cement concrete transomes and mullions of dimensions as indicated in the construction Drawings are generally required to be provided in the half brick partition walls.

Where the drawings indicate that structural steel sections are to be encased in brickwork, the brick masonry shall be built closely against the steel section, ensuring a minimum of 20 mm thick cement-sand mortar 1:4 over all the steel surfaces. Steel sections partly embedded in brickwork shall be provided with bituminous protective coating to the surfaces at the point of entry into the brick masonry.

Contractor shall note that the unit rates quoted for the masonry work shall be deemed to include for the installation of miscellaneous

inserts such as pipe sleeves, bolts, steel sections with anchors etc. and provide pockets, leaving openings, cutting chases etc. in accordance with the construction drawings. Miscellaneous inserts shall be either supplied free by the Employer or to be furnished by the Contractor. Any of the miscellaneous inserts which are required to be fabricated and supplied by the Contractor and cement concrete to be provided in the pockets for holdfasts of door/window frames etc. shall however, be measured and paid for separately under the respective items of work.

Facing bricks of the type specified conforming to IS:2691 shall be laid in the positions indicated on the drawings and all facing brickwork shall be well bonded to the backing bricks/RCC surfaces. The level of execution of the facing brick work shall at any time be lower by at least 600 mm below the level of the backing brickwork.

Facing bricks shall be laid over 10 mm thick backing of cement mortar. The mortar mix, thickness of joint and the type of pointing to be carried out shall be as specified in the item of works. The pattern of laying the bricks shall be as specifically indicated in the drawings.

For facing brickwork, double scaffolding shall be used.

Faced works shall be kept clean and free from damage, discoloration etc., at all times.

Measurement

Measurement shall be in cu.m correct to two places of decimal for brickwork of thickness one brick i.e. 200 mm/230 mm and above. Measurement shall be in sq.m correct to two places decimal for facing brickwork and brickwork of thickness half brick i.e 100mm/115mm and below. Measurement shall be for the quantities as actually executed duly deducting for openings, lintels, transomes/mullions etc. All concrete works shall be measured and paid for separately under the respective items of work.

7.E.3 Uncoursed Random Rubble Masonry in Foundation, Plinth and Superstructure

Materials

Stones for the works shall be of the specified variety which are hard, durable, fine grained and uniform in colour (for superstructure work) free from veins, flaws and other defects. Quality and work shall conform to the requirements specified in IS:1597 (Part-I). The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS:1124. The Contractor shall supply

sample stones to the Engineer for approval. Stones shall be laid with its grains horizontal so that the load transmitted is always perpendicular to the natural bed.

Cement-sand mortar for stone masonry works shall be in the proportion of 1:6. Materials and preparation of mortar shall be as specified in clause 9.2.1.

Workmanship

For all works below ground level the masonry shall be random rubble uncoursed with ordinary quarry dressed stones for the hearting and selected quarry dressed stones for the facing.

For all works above ground level and in superstructure the masonry shall be random rubble uncoursed, well bonded, faced with hammer dressed stones with squared quoins at corners. The bushings on the face shall not be more than 40 mm on an exposed face and on the face to be plastered it shall not project by more than 12 mm nor shall it have depressions more than 10 mm from the average wall surface.

Face stones shall extend back sufficiently and bond well with the masonry. The depth of stone from the face of the wall inwards shall not be less than the height or breadth at the face. The length of the stone shall not exceed three times the height and the breadth on base shall not be greater than three-fourths the thickness of wall nor less than 150 mm. The height of stone may be upto a maximum of 300 mm. Face stones or hearting stones shall not be less than 150 mm in any direction.

Chips and spalls shall be used wherever necessary to avoid thick mortar joints and to ensure that no hollow spaces are left in the masonry. The use of chips and spalls in the hearting shall not exceed 20 percent of the quantity of stone masonry. Spalls and chips shall not be used on the face of the wall and below hearting stones to bring them to the level of face stones.

The maximum thickness of joints shall not exceed 20 mm. All joints shall be completely filled with mortar. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool during the progress of the work while the mortar is still green.

Through or bond stones shall be provided in walls upto 600 mm thick and in case of walls above 600 mm thickness, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous lime stone and sand stone, etc.) the bond stone shall

extend about two-thirds into the wall and a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. Each bond stone or a set of bond stones shall be provided for every 0.5 sq.m of wall surface.

All stones shall be sufficiently wetted before laying to prevent absorption of water from the mortar. All connected walls in a structure shall be normally raised uniformly and regularly. However if any part of the masonry is required to be left behind, the wall shall be raked back (and not saw toothed) at an angle not exceeding 45deg. Masonry work shall not be raised by more than one metre per day.

Green work shall be protected from rain by suitable covering. Masonry work shall be kept constantly moist on all the faces for a minimum period of seven days for proper curing of the joints.

Type of scaffolding to be used shall be as specified in clause 9.2.2.

Measurement

Measurement shall be in cu.m correct to two places of decimal.The quantities measured and paid for, shall be those as actually executed after making necessary deductions for openings, lintels etc.

7.E.4 Coursed Rubble Masonry (First Sort) for Superstructure

Materials

The Material specification for the work shall be as per clause 9.3.1.

Workmanship

All courses shall be laid truly horizontal and shall be of the same height in any course. The height of course shall not be less than 150 mm and not more than 300 mm. The width of stone shall not be less than its height.

Face stones shall tail into the work for not less than their height and atleast 1/3rd the number of stones shall tail into the work for a length not less than twice their height but not more than three-fourths the thickness of the wall whichever is smaller. These should be laid as headers and stretchers alternately to break joints by atleast 75 mm.
The face stones shall be squared on all joints and beds; the bed joints being hammer or chisel dressed true and square for at least 80 mm back from the face and the side joints for atleast 40 mm. The face of the stone shall be hammer dressed so that the bushing shall not be more than 40 mm on an exposed face and 10 mm on a face to be plastered. No portion of the dressed surface shall show a depth of gap

more than 6 mm from a straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints.

No spalls or pinnings shall be allowed on the face. All bed joints shall be horizontal and side joints shall be vertical and no joints shall be more than 10 mm in thickness. When plastering or pointing is not required to be done, the joints shall be struck flush and finished as the work proceeds. Otherwise, the joints shall be raked to a minimum depth of 20 mm by a raking tool, during the progress of the work while the mortar is still green.

Hearting shall consist of flat bedded stones carefully laid on their proper beds and solidly bedded in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10 percent of the quantity of the stone masonry. Care shall be taken so that no hollow spaces are left anywhere in the masonry.

The requirement regarding through or bond stones shall be as specified in clause 9.4.2 with the further stipulation that these shall be provided at 1.5 m to 1.8m apart clear in every course but staggered at alternate courses.

The quoins which shall be of the same height as the course in which they occur, shall not be less than 450 mm in any direction. Quoin stones shall be laid as stretchers and headers alternately. They shall be laid square on their beds, which shall be rough chisel dressed to a depth of at least 100 mm from the face. These stones shall have a minimum uniform chisel drafts of 25mm width at four edges, all the edges being in the same plane.

Type of scaffolding to be used shall be as per Clause 9.2.2.

Requirements of execution of the work and curing shall be as stipulated in clause 9.3.2 .

Measurement

Measurement shall be in cu.m correct to two places of decimal. The quantities measured and paid for, shall be those as actually executed after making necessary deductions for openings, lintels etc.

7.E.5 Concrete Block Masonry

Materials

Masonry units of hollow and solid concrete blocks shall conform to the requirements of IS : 2185 (Part 1).

Masonry units of hollow and solid light-weight concrete blocks shall conform to the requirements of IS : 2185 (Part 2).

Masonry units of autoclaved cellular concrete blocks shall conform to the requirements of IS:2185 (Part 3).

The height of the concrete masonry units shall not exceed either its length or six times its width.

The nominal dimensions of concrete block shall be as under.

Length 400, 500 or 600 mm
Height 100 or 200 mm
Width 100 to 300 mm in 50 mm increments

Half blocks shall be in lengths of 200, 250 or 300mm to correspond to the full length blocks. Actual dimensions shall be 10mm short of the nominal dimensions.

The maximum variation in the length of the units shall not be more than ±5 mm and maximum variation in height or width of the units shall not be more than ± 3mm.
Concrete blocks shall be either hollow blocks with open or closed cavities or solid blocks.

Concrete blocks shall be sound, free of cracks, chipping or other defects which impair the strength or performance of the construction. Surface texture shall as specified. The faces of the units shall be flat and rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surfaces shall be at right angles to the faces of the block.

The concrete mix for the hollow and solid concrete blocks/light weight concrete blocks shall not be richer than one part of cement to six parts of combined aggregates by volume.

Concrete blocks shall be of approved manufacture, which satisfy the limitations in the values of water absorption, drying shrinkage and moisture movement, as specified for the type of block as per relevant IS code. Contractor shall furnish the test certificates and also supply the samples for the approval of Engineer.

Workmanship
The type of the concrete block, thickness and grade based on the compressive strength for use in load bearing and/or non-load bearing walls shall be as specified. The minimum nominal thickness of non-load bearing internal walls shall be 100mm. The minimum nominal

thickness of external panel walls in framed construction shall be 200 mm.

The workmanship shall generally conform to the requirements of IS:2572 for concrete block masonry, IS:6042 for light weight concrete block masonry and IS:6041 for autoclaved cellular concrete block masonry works.

From considerations of durability, generally concrete block masonry shall be used in superstructure works above the damp-proof course level.

Concrete blocks shall be embedded with a mortar which is relatively weaker than the mix of the blocks in order to avoid the formation of cracks. Cement mortar of proportion 1:6 shall be used for the works. Preparation of mortar shall be as specified in clause 9.2.1.

The thickness of both horizontal and vertical joints shall be 10mm. The first course shall be laid with greater care, ensuring that it is properly aligned, levelled and plumb since this will facilitate in laying succeeding courses to obtain a straight and truly vertical wall. For the horizontal (bedding) joint, mortar shall be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of 10mm. For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or on the edges of the succeeding unit when it is standing vertically and then placing it horizontally, well pressed against the previously laid unit to produce a compacted vertical joint. In case of two cell blocks with slight depression on the vertical sides these shall also be filled up with mortar to secure greater lateral rigidity. To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of the block as the mortar will stiffen and lose its plasticity Mortar while hardening shrinks slightly and thus pulls away from the edges of the block. The mortar shall be pressed against the units with a jointing tool after it has stiffened to effect intimate contact between the mortar and the unit to obtain a weather tight joint. The mortar shall be raked to a depth of 10mm as each course is laid to ensure good bond for the plaster.

Dimensional stability of hollow concrete blocks is greatly affected by variations of moisture content in the units. Only well dried blocks should be used for the construction. Blocks with moisture content more than 25% of maximum water absorption permissible shall not be used. The blocks should not be wetted before or during laying in the walls. Blocks should be laid dry except slightly moistening their surfaces on which mortar is to be applied to obviate absorption of water from the mortar.

As per the design requirements and to effectively control cracks in the masonry, RCC bound beams/studs, joint reinforcement shall be provided at suitable locations. Joint reinforcement shall be fabricated either from mild steel wires conforming to IS:280 or welded wire fabric/high strength deformed basis as per the drawings.

For jambs of doors, windows and openings, solid concrete blocks shall be provided. If hollow units are used, the hollows shall be filled with concrete of mix 1:3:6. Hold fasts of doors/windows should be arranged so that they occur at block course level.

At intersection of walls, the courses shall laid up at the same time with a true masonry bond between atleast 50% of the concrete blocks. The sequence for construction of partition walls and treatment at the top of load bearing walls for the RCC slab shall be as detailed under clause 9.2 for the brick work.

Curing of the mortar joints shall be carried out for atleast 7 days. The walls should only be lightly moistened and shall not be allowed to become excessively wet.

Double scaffolding as per clause 9.2.2 shall be adopted for execution of block masonry work.

Cutting of the units shall be restricted to a minimum. All horizontal and vertical dimensions shall be in respectively, adopting modular co-ordination for walls, opening locations for doors, windows etc.

Concrete blocks shall be stored at site suitably to avoid any contact with moisture from the ground and covered to protect against wetting.

Measurement
Measurement shall be in cu.m. correct upto two places of decimal for walls of thickness 200 mm and above. Measurement shall be in sq.m correct upto two places of decimal for walls of 100 mm/150 mm in thickness. Measurement shall be for the quantities as actually executed duly deducting for openings and concrete works. Concrete and reinforcement will be measured and paid for separately. The rate quoted shall be for the type of masonry blocks specified in the respective items of work which shall include for the specific sequential operations as stipulated in the construction drawings.

7.E.6 Damp - Proof Course

Materials and Workmanship

Where specified, all the walls in a building shall be provided with damp-proof course cover plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other openings. Damp-proof course shall consist of 50 mm thick cement concrete of 1:2:4 nominal mix with approved water-proofing compound admixture conforming to IS: 2645 in proportion as directed by the manufacturer. Concrete shall be with 10 mm down graded coarse aggregates.

The surface of brick work/stone masonry work shall be levelled and prepared before laying the cement concrete. Side shuttering shall be properly fixed to ensure that slurry does not leak through and is also not disturbed during compaction. The upper and side surface shall be made rough to afford key to the masonry above and to the plaster.

Damp-proof course shall be cured properly for atleast seven days after which it shall be allowed to dry for taking up further work.

Measurement

Measurement of damp-proof course shall be in sq.m correct to two places of decimal as actually executed. No separate payment will be made for formwork.

7.E.7 Miscellaneous Inserts, Bolts etc.

All the miscellaneous inserts such as bolts, pipes, plate embedments etc., shall be accurately installed in the building works at the correct location and levels, all as detailed in the construction drawings. Contractor shall prepare and use templates for this purpose, if so directed by the Engineer. In the event, of any of the inserts are improperly installed, Contractor shall make necessary arrangements to remove and reinstall at the correct locations/levels, all as directed by the Engineer without any extra cost to the Employer.

7.E.7 .1 Measurement

Miscellaneous inserts, supplied by the Contractor shall be measured and paid for as per the respective items of work.

7.E.8 Wood Work in Doors, Windows, Ventilators & Partitions

Materials

Timber to be used shall be first class Teak wood as per IS:4021. Timber shall be of the best quality and well seasoned by a suitable process before being planed to the required sizes. The maximum permissible moisture content shall be from 10 to 16 percent for timber 50mm and above in thickness and 8 to 14 percent of timber

less than 50mm in thickness for different regions of the country as stipulated in IS:287. Timber shall be close grained, of uniform colour and free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, borer holes, splits and cracks.

Flush door shutters of the solid core type with plywood face panels shall conform to IS:2202 (Part 1) and with particle board/hard board face panels shall conform to IS:2202 (Part 2).

Transparent sheet glass shall conform to the requirements of IS:2835. Wired and figured glass shall be as per IS:5437.

Builder's hardware for fittings and fixtures shall be of the best quality from approved manufacturers.

Workmanship

The workmanship and finish of wood work in doors, windows, ventilators and partitions shall be of a very high order. Contractor shall ensure that work is executed in a professional manner by skilled carpenters for good appearance, efficient and smooth operation of the shutters.

All works shall be executed as per the detailed drawings and/or as directed by the Engineer.

All members of the door, window, and ventilator shall be straight without any warp or bow and shall have smooth well planed faces. The right angle shall be checked from the inside surfaces of the respective members of the frame. Frames shall have mortice and tenon joints which shall be treated with an approved adhesive and provided with metal or wood pins. The vertical members of the door frame shall project 50 mm below the finished floor level. The finished dimension of frames shall be rebated on the solid for keying with the plaster and for receiving the shutters. The depth of rebate for housing the shutter shall be 15 mm. The size of the frames shall be as specified in the respective items of work. The workmanship shall generally conform to the requirements specified in IS:4021.
The face of the frames abutting the masonry or concrete shall be provided with a coat of coal tar.

Three hold fasts using 25 mm x 6 mm mild steel flats 225 mm long with split ends shall be fixed on each side of door and window frames, one at the centre and the other two at 300 mm from the top and bottom of the frame. For window and ventilator frames less than 1 m in height, two hold fasts on each side shall be fixed at quarter points.

Timber panelled shutters for doors, windows and ventilators shall be constructed in the form of framework of stiles and rails with panel

insertion. The panels shall be fixed by either providing grooves in the stiles and rails or by beading. Glazing bars shall be as detailed in the drawings. The stiles and rails shall be joined by mortice and tenon joints at right angles. All members of the shutter shall be straight without any warp or bow and shall have smooth, well planed faces at right angles to each other. The right angle for the shutter shall be checked by measuring the diagonals and the difference shall not be more than ± 3 mm. Timber panels made from more than one piece shall be jointed with a continuous tongued and grooved joint, glued together and reinforced with metal dowels. The workmanship shall generally conform to the requirements specified in IS:1003 (Parts 1 & 2). The thickness of the shutter, width/thickness of the stiles/rails/panel type shall be as specified. Marine plywood panels conforming to IS:710 shall be used for doors where specified.
Details of the wooden flush door shutters, solid core type with specific requirement of the thickness, core, face panels, viewing glazed panel, venetian louvre opening, teak wood lipping etc. shall be as specified. Panels of shutter shall be of marine plywood conforming to IS:710. Flush door shutters shall be from reputed manufacturers and Contractor shall submit test results as per IS:4020, if so desired by the Engineer.

Glazing of door, window, ventilator and partitions shall be with either flat transparent sheet glass, wired or figured glass. Transparent sheet glass shall be of 'B' quality as per IS:2835.The thickness and type of glazing to be provided shall be as specified in the item of work.

The material of the fittings and fixtures either of chromium plated steel, cast brass, copper oxidised or anodised aluminium shall be as specified. The number, size and type of the fittings and fixtures shall be as indicated in the drawings/item of work.

Wood work shall not be provided with the finishes of painting/varnishing etc. unless it has been approved by the Engineer. The type of finish and the number of coats shall be as stipulated in the respective items of work.

Wooden hand railing and architraves shall be of the size and shape with the fixing arrangement as indicated in the drawings.

The framework of the partitions with mullions and transomes shall be with the sections of dimensions as specified. Panels of double/single glazing/plywood shall be fixed as per details specified. Partitions shall be fixed rigidly between the floor and structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the Construction drawings.

Any carpentry work which show defects due to inadequate seasoning of the timber or bad workmanship shall be removed and replaced by Contractor with work as per Specifications at no extra cost to the Employer.

Measurement
Measurement for doors, windows, ventilators, architraves and partitions shall be in sq.m correct to two places of decimal. Handrailing shall be measured in running metres correct to two places of decimal. Measurement shall be from out to out of the frames. Rates quoted shall be for all the works including glazing, painting, Builder's hardware of fittings and fixtures as specifically described in the respective items of work.

7.E.9 Steel Doors, Windows and Ventilators

Materials
Hot rolled steel sections for the fabrication of steel doors, windows and ventilators shall conform to IS : 7452 which are suitable for single glazing .

Pressed steel door frames for steel flush doors shall be out of 1.25mm thick mild steel sheets of profiles as per IS : 4351.

Transparent sheet glass shall conform to the requirements of IS : 2835. Wired and figured glass shall be as per IS : 5437.

Builder's hardware of fittings and fixtures shall be of the best quality from the approved manufacturers.

Workmanship
All steel doors, windows and ventilators shall be of the type as specified in the respective items of work and of sizes as indicated in the drawings. Steel doors, windows and ventilators shall conform to the requirements as stipulated in IS : 1038. Steel windows shall conform to IS : 1361, if so specified.

Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the unit shall be with rolled section, cut to correct lengths and mitred. Corners shall be welded to form a solid fused welded joint conforming to the requirements of IS : 1038. Tolerance in overall dimensions shall be within ±1.5mm. The frames and shutters shall be free from wrap or buckle and shall be square and truly plain. All welds shall be dressed flush on exposed and contact surfaces. Punching of holes, slots and other provisions to install fittings and fixtures later shall be made at the correct locations as per the requirements. Samples of the units shall be got approved by the Engineer before further manufacture/purchase by the Contractor.

Type and details of shutters, hinges, glazing bar requirement, couplings, locking arrangement, fittings and fixtures shall be as described in the respective items of work and / or as shown in the drawings for single or composite units.

For windows with fly proof mesh as per the item of work, rotor operator arrangement, for the operation of the glazed shutters from the inside shall be provided.

Pressed steel door frames shall be provided with fixing lugs at each jamb, hinges, lock-strike plate, mortar guards, angle threshold, shock-absorbers of rubber or similar material as per the requirements of IS : 4351. Pressed steel door frames shall be fixed as `built-in' as the masonry work proceeds. After placing it plumb at the specified location, masonry walls shall be built up solid on either side and each course grouted with mortar to ensure solid contact with the door frame, without leaving any voids. Temporary struts across the width shall be fixed, during erection to prevent bow/sag of the frame.

Door shutters of flush welded construction shall be 45mm thick, fabricated with two outer skins of 1.25mm thick steel sheets, 1mm thick steel sheet stiffeners and steel channels on all four edges. Double shutters shall have meeting stile edge bevelled or rebated. Provision of glazed viewing panel, louvers shall be made as per the items of works and/or drawings. Shutters shall be suitably reinforced for lock and other surface hardware and to prevent sagging/twisting. Single sheet steel door shutters shall be fabricated out of 1.25mm thick steel sheets, mild steel angles and stiffeners as per the drawings.

Doors, windows and ventilators shall be fixed into the prepared openings. They shall not be 'built-in' as the masonry work proceeds, to avoid distortion and damage of the units. The dimensions of the masonry opening shall have 10mm clearance alround the overall dimensions of the frame for this purpose. Any support of scaffolding members on the frames/glazing bars is prohibited.

Glazing of the units shall be either with flat transparent glass or wired / figured glass of the thickness as specified in the items of works. All glass panels shall have properly squared corner and straight edges. Glazing shall be provided on the outside of the frames.

Fixing of the glazing shall be either with spring glazing clips and putty conforming to IS:419 or with metal beads. Pre-formed PVC or rubber gaskets shall be provided for fixing the beads with the

concealed screws. The type of fixing the glazing shall be as indicated in the items of work and/or in drawings.

Steel doors, windows and ventilators shall be provided with finish of either painting as specified or shall be hot dip galvanised with thickness of the zinc coating as stipulated all as described in the respective items of works.

The material of the Builders hardware of fittings and fixtures of chromium plated steel, cast brass, brass copper oxidised or anodised aluminium shall be as specified in the items of works. The number, size and type of fittings and fixtures shall be as in the Drawings /items of work.

Installation of the units with fixing lugs, screws, mastic caulking compound at the specified locations shall generally conform to the requirements of IS:1081. Necessary holes etc required for fixing shall be made by the Contractor and made good after installation. Workmanship expected is of a high order for efficient and smooth operation of the units.

Measurement
Measurement shall be in sq.m correct to two places of decimal. Measurement shall be from out to out of the frames. Rates quoted shall be for the works including glazing, painting, Builder's hardware of fittings and fixtures as specifically described in the respective items of work.

7.E.10 Aluminium Doors, Windows, Ventilators & Partitions

Materials
Aluminum alloy used in the manufacture of extruded sections for the fabrication of doors, windows, ventilators shall conform to designation HE9-WP of IS:733.

Transparent sheet glass shall conform to the requirements of IS:2835. Wired and figured glass shall be as per IS:5437.

Builder's hardware of fittings & fixtures shall be of the best quality from approved manufacturers.

Workmanship
All aluminum doors, windows, ventilators and partitions shall be of the type and size as specified. The doors, windows, ventilators shall conform to the requirements of IS:1948. Aluminum windows, shall conform to IS:1949, if so specified.

All aluminum units shall be supplied with anodized finish. The minimum anodic film thickness shall be 0.015 mm.

Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the units shall be with the extruded sections, cut to correct lengths, metered and welded at the corners to a true right angle conforming to the requirements of IS:1948. Tolerance in overall dimensions shall be within ± 1.5mm. The frames and shutters shall be free from warp or buckle and shall be square and truly plane. Punching of holes, slots and other provisions to install fittings or fixtures later shall be made at the correct locations, as per the requirements.

Aluminium swing type doors, aluminum sliding windows, partitions shall be as described in the items of work / drawings.

IS:1948 and IS:1949 refers to incorporating the sizes, shapes, thicknesses and weight per running metre of extruded sections for various components of the units. However, new sizes, shapes, thicknesses with modifications to suit snap-fit glazing clips etc. are continuously being added by various leading manufacturers of extruded sections, which are available in the market. As such, the sections of the various components of the unit proposed by the Contractor, will be reviewed by the Engineer and will be accepted only if they are equal to or marginally more than that given in the codes / specified in the items of work.

The framework of the partitions with mullions and transomes shall be with anodised aluminium box sections. Anodised aluminium box sections shall be in-filled with timber of class 3 (silver oak or any other equivalent) as per IS:4021. Panels of double/single glazing/plywood shall be fixed as per details indicated in the drawings. Partitions shall be fixed rigidly between the floor and the structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction drawings.

Specific provisions as stipulated for steel doors, windows, ventilators under clause 9.9.2 shall also be applicable for this item work. Glazing beads shall be of the snap-fit type suitable for the thickness of glazing proposed as indicated in the items of works. A layer of clear transparent lacquer shall be applied on aluminium sections to protect them from damage during installation. This lacquer coating shall be removed after the installation is completed.

Measurement
Measurement shall be in sq.m correct to two places of decimal. Measurement shall be from out of the frames. Rate quoted shall be for the works including glazing, Builder's hardware of fittings and fixtures as specifically described in the respective items of work.

7.E.11 Steel Rolling Shutters

Materials and Workmanship
Rolling shutters shall be of an approved manufacture, conforming to the requirements specified in IS:6248.

The type of rolling shutter shall be self coiling type (manual) for clear areas upto 12 sq.m, gear operated type (mechanical) for clear areas upto 35 sq.m and electrically operated type for areas upto 50 sq.m. Mechanical type of rolling shutters shall be suitable for operation from both inside and outside with the crank handle or chain gear operating mechanism duly considering the size of wall/column. Electrical type of rolling shutter shall also be provided with a facility for emergency mechanical operation.

Rolling shutters shall be supplied duly considering the type, specified clear width/height of the opening and the location of fixing as indicated in the drawings.

Shutters shall be built up of interlocking laths 75 mm width between rolling centres formed from cold rolled steel strips. The thickness of the steel strip shall not be less than 0.90 mm for shutters upto 3.50m width and not less than 1.20 mm for shutters above 3.50 m width. Each lath section shall be continuous single piece without any welded joint.

The guide channels out of mild steel sheets of thickness not less than 3.15 mm shall be of either rolled, pressed or built up construction. The channel shall be of size as stipulated in IS:6248 for various clear widths of the shutters.

Hood covers shall be of mild steel sheets not less than 0.90 mm thick and of approved shape.

Rolling shutters shall be provided with a central hasp and staple safety device in addition to one pair of lever locks and sliding locks at the ends.

All component parts of the steel rolling shutter (excepting springs and insides of guide channels) shall be provided with one coat of zinc chrome primer conformity to IS:2074 at the shop before supply.

These surfaces shall be given an additional coat of primer after erection at the site along with the number of coats and type of finish paint as specified in the respective items of work.

In case of galvanised rolling shutter, the lath sections, guides, lock plate, bracket plates, suspension shaft and the hood cover shall be hot dip galvanised with a zinc coating containing not less than 97.5 percent pure zinc. The weight of the zinc coating per sq.m shall be as specified in the items of work.

Guide channels shall be installed truly plumb at the specified location. Bracket plate shall be rigidly fixed with necessary bolts and holdfasts. Workmanship of erection shall ensure strength and rigidity of rolling shutter for trouble free and smooth operation.

Measurement
Measurement shall be in sq.m correct to two places of decimal of the clear area of the opening. Quoted rate shall be inclusive of painting as specified in the item of work.

7.E.12 Rubble Sub-Base

Materials
Stones used for rubble packing under floors on grade, foundations etc., shall be clean, hard, durable rock free from veins, flaws, laminations, weathering and other defects. Stones shall generally conform to the requirements stipulated in IS: 1597 (Part I).

Stones shall be as regular as can be obtained from quarries. Stones shall be of height equal to the thickness of the packing proposed with a tolerance of ± 10 mm. Stones shall not have a base area neither less than 250 sq cm nor more than 500 sq.cm, and the smallest dimension of any stone shall not be less than half the largest dimension. The quality and size of stones shall be subject to the approval of the Engineer.

Workmanship
Stones shall be hand packed carefully and laid with their largest base downwards resting flat on the prepared sub-grade and with their height equal to the thickness of the packing. Stones shall be laid breaking joints and in close contact with each other. All interstices between the stones shall be wedged-in by small stones of suitable size, well driven in by crow bars and hammers to ensure tight packing and complete filling-in of the interstices. The wedging shall be carried out simultaneously with the placing in position of rubble packing and shall not lag behind. After this, any interstices between

the smaller wedged stones shall be infilled with clean hard sand by brooming so as to fill the joints completely.

The laid rubble packing shall be sprinkled with water and compacted by using suitable rammers.

Measurement
Measurement shall be in sq.m correct to two places of decimal for the specified compacted thickness of rubble sub-base.

7.E.13 Base Concrete
The thickness and grade of concrete and reinforcement shall be as specified in items of work.

Before placing the blinding concrete, the sub-base of rubble packing shall be properly wetted and rammed. Concrete for the base shall then be deposited between the forms, thoroughly tamped and the surface finished level with the top edges of the forms. Two or three hours after the concrete has been laid in position, the surface shall be roughened using steel wire brush to remove any scum or laitance and swept clean so that the coarse aggregates are exposed. The surface of the base concrete shall be left rough to provide adequate bond for the floor finish to be provided later.

Measurement
Measurement shall be in sq.m correct to two places of decimal. This work could be either separate or combined along with the floor finish as indicated in the respective items of work.

7.E.14 In-Situ Cement Concrete Floor Topping

Materials
The mix proportion for the in-situ concrete floor topping shall be 1:2.5:3.5 (one part cement : two and half parts sand : three and half parts coarse aggregates) by volume unless otherwise specified in the items of work.

The aggregates shall conform for the requirements of IS:383.

Coarse aggregates shall have high hardness surface texture and shall consist of crushed rock of granite, basalt, trap or quartzite. The aggregate crushing valve shall not exceed 30 percent. The grading of the aggregates of size 12.5mm and below shall be as per IS:2571.

Grading of the sand shall be within the limits indicated in IS:2571.

Workmanship

The thickness of the floor topping shall be as specified in the items of work. The minimum thickness of the floor topping shall be 25mm.

Preparation of base concrete/structural slab before laying the topping shall be as per clause 9.13. The surface shall be rough to provide adequate bond for the topping.

Mixing of concrete shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the Engineer. The concrete shall be as stiff as possible and the amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and compacting. The mix shall be used in the work within 30 minutes of the addition of water for its preparation.

Floor finish shall be laid in suitable panels to reduce the risk of cracking. No dimension of a panel shall exceed 2 meters and the length of a panel shall not exceed one and a half times its breadth. Topping shall be laid in alternate panels, the intermediate panels being cast after a gap of atleast one day. Construction joints shall be plain vertical butt joints.

Screed strips shall be fixed dividing the area into suitable panels. Immediately before depositing the concrete topping, neat cement slurry at 2.75 kg/sq.m of area shall be thoroughly brushed into the prepared surface. Topping shall then be laid, very thoroughly tamped, struck off level and floated with wooden float. The surface shall then be tested with a straight edge and mason's spirit level to detect any inequalities and these shall be made good immediately.

Finishing of the surface by troweling shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled 3 times at intervals so as to produce a smooth uniform and hard surface. Immediately after laying, the first trowelling just sufficient to give a level surface shall be carried out avoiding excessive trowelling at this stage. The surface shall be re- trowelled after sometime to close any pores and to scrap off excess water or laitance, which shall not be trowelled back into the topping. Final trowelling shall be done well before the concrete has become too hard but at a time when considerable pressure is required to make any impression on the surface. Sprinkling of dry cement or cement-sand mixture for absorbing moisture shall not be permitted.

Immediately after the surface is finished, it shall be protected suitably from rapid drying due to wind/ sunlight. After the surface has

hardened sufficiently to prevent any damage to it, the topping shall be kept continuously moist for a minimum period of 10 days.

It is preferable to lay the topping on hardened base concrete, as against being laid monolithically with a lesser thickness, since proper levels and slopes with close surface tolerances is achievable in practice, owing to its greater thickness. Further, as this would be laid after all other building operations are over, there will be no risk of any damages or discoloration to the floor finish which are difficult to repair satisfactorily.

Measurement
Measurement shall be in sq.m correct upto two places of decimal.

7.E.15 In-Situ Granolithic Concrete Floor Topping

Materials and Workmanship
The requirements of materials and workmanship shall be all as per clause 9.19 for in-situ cement concrete floor topping except that the mix proportion of the concrete shall be 1:1:2 (cement:sand:coarse aggregates) by volume.

The minimum thickness of granolithic floor topping on hardened concrete base shall be 40mm.

Measurement
Measurement shall be in sq.m correct upto two places of decimal.

7.E.16 Floor Hardener Topping

Materials & Workmanship
Floor hardener topping shall be provided either as integrally finished over the structural slab/grade slab or laid monolithically with the concrete/granolithic floor finish on top of hardened concrete base.

Floor hardener of the metallic or non-metallic type suitable for the performance of normal / medium/ heavy duty function of the floor, the quantum of ingredients and the thickness of topping shall be as specified in the respective items of work.

For monolithic application with the floor finish/slab the thickness of the layer shall be 15mm. The topping shall be laid within 2 to 3 hours after concrete is laid when it is still plastic but stiffened enough for the workmen to tread over it by placing planks. The surface of the concrete layer shall be kept rough for providing adequate bond for the topping. Laitance shall be removed before placing the topping. The topping shall be screened and thoroughly compacted to the finished level. Trowelling to a smooth finish shall be carried out as

per clause 9.19.2. After the surface has hardened sufficiently, it shall be kept continuously moist for atleast 10 days.

The procedure for mixing the floor hardener topping shall be as per manufacturer's instructions.

Surface shall be prevented from any damages due to subsequent building operations by covering with 75 mm thick layer of sand.

Measurement
Measurement shall be in sq.m correct to two places of decimal.This could be either seperate or combined along with the floor finish as indicated in the respective items of work.

7.E.17 Water-Proofing

Machine made flat Yelahanka tiles shall be of the size and thickness as specified in the item of work. Tiles shall be soaked in water for atleast one hour before laying. The tiles shall be laid on a mortar bed of cement mortar 1:3 with an average thickness of 25mm. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and to set to plane surface true to slope, using trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally at right angles to the direction on run-off gradient. Transverse joints in alternate rows shall come directly in line with each other. Transverse joints in adjacent courses shall break joints by at least 50 mm. The joints shall be completely filled and flush pointed with cement mortar 1:3 mixed with red-oxide. Curing shall be carried out for a minimum period of seven days.

General
The work shall include waterproofing for the building roofs, terraces, toilets, floor slabs, walls, planters, chajjas, sills and any other areas and at any other locations and situations as directed by the Engineer.

The waterproofing treatment shall be carried out on top of lime concrete (brick bat coba) laid to slope on roof surfaces. The brick bat coba shall be covered as specified below.

The work shall be carried out by an experienced specialist Sub-Contractor who shall be appointed only after prior approval of the Engineer.

Waterproofing of Roofs with Lime Concrete

Materials
Broken brick coarse aggregates prepared from well/over burnt bricks shall be well graded having a maximum size of 25mm and shall generally conform to IS:3068.

Lime shall be class C lime (fat lime) or factory made hydrated lime conforming to IS:712.

Workmanship
Lime concrete shall be prepared by thoroughly mixing the brick aggregates inclusive of brick dust obtained during breaking with the slaked lime in the proportions of 2 1/2 (two and a half) parts of brick aggregates to 1 part of slaked lime by volume. Water shall be added just adequate to obtain the desired workability for laying. Washing soap and alum shall be dissolved in the water to be used. The quantity of these materials required per cum of lime concrete shall be 12kg of washing soap and 4kg of alum. Brick aggregates shall be soaked thoroughly in water for a period of not less than six hours before use in the concrete mix. Lime concrete shall be used in the works within 24 hours after mixing.

The roof surface over which the water-proof treatment is to be carried out shall be cleaned of all foreign matter by wire brushing, dusting and made thoroughly dry. Preparation of surfaces shall be as stipulated in IS:3067.

The slope of the finished waterproofing treatment shall be not less than 1 in 60 for efficient drainage. This shall be achieved either wholly in the lime concrete layer or otherwise as indicated in the drawings.

The average thickness of lime concrete, slope and the finish on top of machine made burnt clay flat terracing tiles conforming to IS:2690 (part I) shall be as specified in the items of work. Cement concrete flooring tiles in lieu of clay terracing tiles shall be provided if so specified in the items of work, duly considering the traffic the terrace will be subjected to.

The minimum compacted thickness of lime concrete layer shall be 75mm and average thickness shall not be less than 100mm. In case, the thickness is more than 100mm, it shall be laid in layers not exceeding 100mm to 125mm.
Laying of lime concrete shall be commenced from a corner of the roof and proceeded diagonally towards centre and other sides duly considering the slopes specified for effectively draining the rain-water towards the downtake points.

Lime concrete fillet for a minimum height of 150mm shall be provided all along the junction of the roof surface with the brick masonry wall/parapet/column projections. These shall then be finished on top with provision of clay terracing tiles/cement concrete tiles.

After the lime concrete is laid it shall be initially rammed with a rammer weighing not more than 2 Kg and the finish brought to the required evenness and slope. Alternatively, bamboo strips may be used for the initial ramming. Further consolidation shall be done using wooden THAPIES with rounded edges. The beating will normally have to be carried on for at least seven days until the THAPI makes no impression on the surface and rebounds readily from it when struck. Special care shall be taken to properly compact the lime concrete at its junction with parapet walls or column projections.

During compaction by hand-beating, the surface shall be sprinkled liberally with lime water (1 part of lime putty and 3 to 4 parts of water) and a small proportion of sugar solution for obtaining improved water-proofing quality of the lime concrete. On completion of beating, the mortar that comes on the top shall be smoothened with a trowel or float, if necessary, with the addition of sugar solution and lime putty. The sugar solution may be prepared in any one of the following ways as directed by the Engineer.

a) By mixing about 3 Kg of Jaggery and 1.5 Kg of BAEL fruit to 100 litres of water.
b) By mixing about 600 gm of KADUKAI (the dry nuts shall be broken to small pieces and allowed to soak in water), 200 gm of jaggery and 40 litres of water for 10 sq.m of work. This solution shall be brewed for about 12 to 24 hours and the resulting liquor decanted and used for the work.

The lime concrete after compaction shall be cured for a minimum period of seven days or until it hardens by covering with a thin layer of straw or hessian which shall be kept wet continuously.

Machine made flat terracing tiles shall be of the size and thickness as specified. Tiles shall be soaked in water for at least one hour before laying. Bedding for the tiles shall be 12mm thick in cement mortar 1:3. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and set to plane surface true to slope, using a trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally at right angles to the direction of run-off gradient. Transverse joints in alternate rows shall come directly in line with each other. Transverse joints in adjacent courses shall break joints by atleast 50 mm. The joints shall be completely filled and flush pointed with cement mortar

1:2 mixed with water proofing compound as per manufacturer's instructions. Curing shall be carried out for a minimum period of seven days.

Finishing on top with cement concrete tiles or in-situ cement concrete floor topping shall be carried out in similar fashion as described for clay tiles in above the paragraph. Tiles to be used shall be supplied after the first machine grinding of the surface.

Measurement
Measurement shall be in sq.m correct to two places of decimal. Measurement shall be for the plan area where the treatment is executed. No separate payment shall be made for the fillets.

Khurras and Rainwater Down Pipes
Down pipes shall be isolated from RCC work with 6 mm polyethylene foam fixed with adhesive (Araldite) and sealed with silicone sealant prior to laying membrane. A water proofing flashing composed of one layer of Hessian based self finished felt Type 3 Grade 1 and two layers of aluminium foil of 0.075 mm thickness shall be provided. This flashing shall be carried into the down take pipes for at least 150 mm and sealed with hot bitumen. The Contractor shall closely coordinate the work with the agency providing and fixing the rainwater down take pipes.

Testing
The treated area (flat and horizontal only) shall be tested by allowed water to stand on the treated areas to a depth of 150 mm for a minimum period of 72 hours.

The treated area (flat and horizontal) shall have continuous slope towards the rainwater outlets and no water shall pond anywhere on the surface.

7.E.18 Cement Plastering Work

Materials
The proportions of the cement mortar for plastering shall be 1:4 (one part of cement to four parts of sand). Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS standards. The quality and grading of sand for plastering shall conform to IS:1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the Engineer. If so desired by the Engineer sand shall be screened and washed to meet the Specifications. The mortar thus

mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re- tempered by adding water as required to restore consistency but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

Workmanship

Preparation of surfaces and application of plaster finishes shall generally conform to the requirements specified in IS:1661 and IS:2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window panels, pipes, conduits etc. are completed.

All joints in masonry shall be raked as the work proceeds to a depth of 10mm/20mm for brick/stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

Interior plain faced plaster - This plaster shall be laid in a single coat of 13mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by the Engineer.

Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 6mm thickness. Application of mortar shall be as stipulated in above paragraph.

Exterior plain faced plaster - This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14mm thick. The rendering coat shall be applied as stipulated above except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. The

rendering coat shall be cured for atleast two days and then allowed to dry. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for atleast 7 days.

Interior plain faced plaster 20mm thick if specified for uneven faces of brick walls or for random/coursed rubble masonry walls shall be executed in 2 coats similar to the procedure stipulated in above paragraph.

Exterior Sand Faced Plaster- This plaster shall be applied in 2 coats. The first coat shall be approximately 14mm thick and the second coat shall be 6mm thick. These coats shall be applied as stipulated above. However, only approved quality white sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.

Wherever more than 20mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the Engineer duly satisfying the requirements of curing each coat (rendering/floating) for a minimum period of 2 days and curing the finished work for atleast 7 days.

In the case of pebble faced finish plaster, pebbles of approved size and quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the Engineer.

Where specified in the drawings, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the drawings.

Curing of plaster shall be started as soon as the applied plaster has hardened sufficiently so as not to be damaged when watered. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

For waterproofing plaster, the Contractor shall provide the water-proofing admixture as specified in manufacturers instruction while preparing the cement mortar.

For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking points like doors/windows etc. Ceiling plaster shall be completed first before commencing wall plastering.

Double scaffolding to be used shall be as specified in clause 9.2.2.

The finished plaster surface shall not show any deviation more than 4mm when checked with a straight edge of 2m length placed against the surface.

To overcome the possibility of development of cracks in the plastering work following measures shall be adopted.

a) Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.

b) Steel wire fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement.

c) Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

Measurement
Measurement for plastering work shall be in sq.m correct to two places of decimal. Unless a separate item is provided for grooves, mouldings, etc., these works are deemed to be included in the unit rates quoted for plastering work. The quantity of work to be paid for under these items shall be calculated by taking the projected surface of the areas plastered after making necessary deductions for openings for doors, windows, fan openings etc. The actual plaster work carried out on jambs/sills of windows, openings, etc. shall be measured for payment.

7.E.19 Cement Pointing

Materials
The cement mortar for pointing shall be in the proportion of 1:3 (one part of cement to three parts of fine sand). Sand shall conform to IS: 1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by Engineer and if so directed it shall be washed/screened to meet specification requirements.

Workmanship
Where pointing of joints in masonry work is specified, the joints shall be raked at least 15mm/20mm deep in brick/stone masonry respectively as the work proceeds when the mortar is still green.

Any dust/dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or 'V' as may be specified in the respective items of work. No false joints shall be allowed.

The work shall be kept moist for atleast 7 days after the pointing is completed. Whenever coloured pointing has to be done, the colouring pigment of the colour required shall be added to cement in such proportions as recommended by the manufacturer and as approved by the Engineer.

Measurement
The quantity of work to be paid for under this item shall be measured in sq.m. correct to two places of decimal by taking the projected surface of the area pointed after making necessary deductions for openings, etc.

7.E.20 Metal Lath and Wire Fabric

Materials
Welded steel wire fabric shall conform to IS : 4948.

Expanded metal shall conform to IS : 412.

Galvanised wire mesh shall be of approved quality.

Workmanship
The type and details of the steel material to be used for metal lath plastering work and at the junctions of brick masonry/concrete before wall plastering shall be as specified in the respective items of work.

For metal lath plastering work, the weight of steel material shall be not less than 1.6 kg/sq.m.

Steel material for use at the junction of brick masonry/concrete shall have the mesh dimensions not greater than 50 mm.

Steel material shall be obtained in maximum lengths as manufactured to restrict joints to the minimum. Overlap at the joints shall be minimum 25 mm which shall be securely tied with wires of diameter not less than 1.25 mm at spacings not more than 100 mm for lath plastering work. Nailing to wall shall be at spacings not exceeding 200 mm. The material shall be straightened, cut and bent to shape if required for fixing as per the details indicated in the drawings.

Measurement
Measurement shall be in sq.m correct to two places of decimal for the type as specified in the respective items of work.

7.E.21 Water-Proofing Admixtures

Water-proofing admixture shall conform to the requirements of IS:2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the Engineer.

7.E.22 Painting of Concrete, Masonry & Plastered Surfaces

Materials
Oil bound distemper shall conform to IS:428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.

Cement paint shall conform to IS:5410. The primer shall be a thinned coat of cement paint.

Lead free acid, alkali and chlorine resisting paint shall conform to IS:9862.

White wash shall be made from good quality fat lime conforming to IS : 712. It shall be slaked at site and mixed with water in the proportion of 5 litres of water to 1 kg of unslaked lime stirred well to make a thin cream. This shall be allowed to stand for a minimum period of one day and strained through a clean coarse cloth. Four kg of gum dissolved in hot water shall be added to each cu.m of cream. 1.30 kg of sodium chloride dissolved in hot water shall then be added per 10 kg of lime used for the white wash to be ready for application.

Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/tint as approved by the Engineer.

All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the Engineer for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

Workmanship
Contractor shall obtain the approval of the Engineer regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting.

Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub- strata.

The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to IS:2395.

Surfaces of doors, windows etc. shall be protected suitably to prevent paint finishes from splashing on them.

White Wash
The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.

Colour Wash
Colour wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/powdery and come off readily on the hand when rubbed.

Cement Paint
The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint

shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free from pinholes for effective water proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/sq.m. A minimum of 2 coats of the same colour shall be applied. Atleast 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for atleast 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

Oil bound Distemper

The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for atleast 48 hours. A minimum of two coats of oil bound distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. Atleast 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed above.

Acid, Alkali Resisting Paint

A minimum of 2 coats of acid/alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer coat shall be as per manufacturer's instructions.

Plastic Emulsion Paint

The prepared surface shall be dry and provided with one coat of primer which shall be a thinned coat of emulsion paint. The quantity of thinner shall be as per manufacturer's instructions. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally takes about 2 to 3 hours. A minimum of 2 finishing coats of the same colour shall be applied unless otherwise specified. Paint may also be applied using rollers. The surface on

finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

Acrylic Emulsion Paint
Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. A minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified.

Measurement
Measurement shall be in sq.m correct to two places of decimal. Measurement shall be for the areas as executed duly deducting for any openings etc. Rate quoted shall take into account the provision of necessary enabling works such as scaffolding, painter's cradle etc.

7.E.23 Flashing

Materials
Anodised Aluminium sheets shall be 1.00mm thick with anodic film thickness of 0.025 mm.
Galvanised mild steel sheets shall be 1.00mm thick with zinc coating of 800 gms/sq.m.

Bitumen felt shall be either Hessian base self finished bitumen felt Type-3 Grade I conforming to IS:1322 or glass fibre base self finished felt Type-2 Grade 1 conforming to IS:7193.
Workmanship
The type of the flashing and method of fixing shall be as specified.

Flashing shall be of the correct shape and size as indicated in the construction drawings and they shall be properly fixed to ensure their effectiveness.

Flashing shall be of long lengths so as to provide minimum number of joints. The minimum overlap at joints shall be 100mm.

Fixing of the flashing shall be either by bolting with bitumen washers or by tucking into the groove 75 mm wide x 65 mm deep in masonry/concrete alongwith with cement mortar 1:4 filletting as indicated in the Drawings. Curing of the mortar shall be carried out for a minimum period of 4 days.

Bitumen felt flashing of the type as specified shall be provided with 2 coats of bituminous paint at the rate of 0.10 litre/sq.m after the installation.

Measurement
Measurement shall be in sq.m correct to two places of decimal. Measurement shall be for the actual area of the flashing material

provided and the rate shall include for all the incidental works of bending to shape and fixing details as per the construction drawings.

7.E.24 Epoxy Lining Work

Materials
The epoxy resin and hardener formulation for laying of joint less lining work in floors and walls of concrete tanks/trenches etc shall be as per the requirements of IS:9197.

The epoxy composition shall have the chemical resistance to withstand the following conditions of exposure :

a) Hydrochloric acid upto 30% concentration
b) Sodium hydroxide upto 50% concentration
c) Liquid temperature upto 60deg.C
d) Ultraviolet radiation
e) Alternate wetting and drying

Sand shall conform to grading zone III or IV of IS:383.
The hardener shall be of the liquid type such as Aliphatic Amine or an Aliphatic/Aromatic Amine Adduct for the epoxy resin. The hardener shall react with epoxy resin at normal ambient temperature.

Contractor shall furnish test certificates for satisfying the requirements of the epoxy formulation if so directed by the Engineer.

Workmanship
The minimum thickness of epoxy lining shall be 4 mm. It is essential that the concrete elements are adequately designed to ensure that water is excluded to permeate to the surface, over which the epoxy lining is proposed.

The epoxy lining shall be of the trowel type to facilitate execution of the required thickness for satisfactory performance.

The concrete surfaces over which epoxy lining is to be provided shall be thoroughly cleaned of oil or grease by suitable solvents, wire brushed to remove any dirt/dust and laitance. The surfaces shall then be washed with dilute hydrochloric acid and rinsed thoroughly with plenty of water or dilute ammonia solution. The surfaces shall then be allowed to dry. It is essential to ensure that the surfaces are perfectly dry before the commencement of epoxy application.

Just adequate quantity of epoxy resin which can be applied within the pot life as specified by the manufacturer shall be prepared at one time for laying and jointing.
Rigid PVC/stainless steel/chromium plated tools shall be used for laying. Trowelling shall be carried out to obtain uniformly the specified thickness of lining.

Lining shall be allowed to set without disturbance for a minimum period of 24 hours. The facility shall be put to use only after a minimum period of 7 days of laying of the lining.

Measurement
Measurement shall be in sq.m correct to two places of decimal.

End of Part 7E

SPECIFIC TECHNICAL REQUIREMENTS - CIVIL

7.F.1 Scope

This section specifies the specific technical requirements for construction of balancing reservoirs, booster pumping station and allied Works. This section and other specifications are mutually dependent and essential for correct interpretation of the Contract. In case of conflict in any of these specifications, the requirements of this section shall govern.

7.F.2 Excavation

All precaution shall be taken during excavation and construction to guard against possible damage to any existing structure/pipelines etc. Also utmost care shall be taken to prevent side collapses during excavation. No payment for removal of any collapsed earth shall be made.

Contractor shall provide suitable barricade, fencing on all sides of excavation for its full length/perimeter. Also necessary construction signs, red lanterns and guards as required shall be provided and maintained during the progress of construction and pipe laying work.

Stable side slopes to excavation shall be provided wherever permitted by Engineer. The side slopes for excavation towards the building side having independent foundations shall be as steep as possible so as to avoid deep column footings. The side slope shall be as approved by Engineer. Engineer’s approval for side slopes during excavation shall not relieve Contractor from his responsibility for any damage or subsidence. Where side slopes are not feasible and/or not permitted by Engineer, Contractor shall provide suitable shoring and strutting for excavation. Contractor shall suitably design polling boards, walings and struts to meet the different soil conditions that might be encountered in excavating trenches or pits. The horizontal and

vertical spacing of struts shall be such that not only the sides of trenches and pits shall be prevented from collapse but also ease of laying of pipes/construction of structure in trenches/pits shall be ensured without creating undue obstructions for the execution of the work. Any inconvenience and/or delay that might be caused in laying of pipes/construction in trenches/pits as a result of adopting improper spacings of struts by Contractor shall be his sole responsibility.

The Contractor shall take great care to prevent slips and falls of material from the sides of the excavation and embankments.

In the event of slips or falls occurring in the excavations, and where excavations are made in excess of the dimensions of the Permanent Works, the voids so formed shall be filled by the Contractor at his own expense. When such voids may, in the opinion of the Engineer, affect the stability of the ground for the support of the works, or of the adjacent structures and services, the Contractor shall fill the void solid with concrete Class M10 or of the same class as the concrete in adjacent foundations. In other cases the Contractor shall fill the voids with selected excavated material or with granular material placed and compacted to the approval of the Engineer.

If during excavation, any soft or loose soil is met with under the substructure, it shall be immediately informed to Engineer and remedial measures taken as directed by Engineer.

The Contractor shall provide support necessary to ensure the stability of the excavation and adjacent structures.

Unless otherwise approved (eg. when both foundations are in sound rock), where a separate excavation is to be made to a different depth from that of an adjacent part of the Works, whether concurrently or not, then the foundation of the one shall be deepened and filled with concrete Class M10 or the backfill to the other made with concrete Class M10 whichever shall be constructed first, such that foundation pressure stress lines drawn at 40 degrees to the horizontal lie either entirely in undisturbed ground or in concrete Class M10 or better.

The material from excavation shall be deposited at such places as directed by Engineer leaving adequate clear distance from the edge of the trench/pit as may be necessary to prevent the sides of the trench/pit from slipping or collapsing.

Service lines if met with during excavation shall be properly maintained by Contractor by means of shoring, strutting, planking over, padding or otherwise as Employer/Engineer may direct and shall be protected by Contractor from damage during the progress of the work and if damaged, such damage shall be made good either by Contractor or by other agency, as Employer/Engineer may decide and wholly, in either case, at the expenses of Contractor.

Utmost care shall be taken to see that width of trench at the top of pipe is not more than that specified. In case additional width is required it shall be provided only in the top portion from the ground level upto 300 mm above the top of pipe. If any extra width is excavated in the area below this portion Contractor shall have to provide remedial measures as directed by Engineer. Contractor shall not be paid for extra excavation as well as for any remedial measures.

The excess excavated material shall be carried away from site of works to a place as identified by the Contractor in accordance with Clause 2.3 of Specifications. The Contractor shall dispose the material in such a way, so as not to cause any inconvenience to other agencies, failing which, Employer/Engineer shall carry out the work by any other agency at Contractor's risk and cost. If the instructions from Engineer are not followed within seven days from the date of instructions to cart the materials and to clear the Site, the same shall be carried out by Employer/Engineer at the risk and cost of Contractor and no claim or dispute shall be entertained in this respect.

Excavation in Rock by Controlled Blasting

Excavation in rock by blasting / controlled blasting shall not be allowed.

Excavation in Rock by Chiseling

This includes rock which is easily excavated by blasting, but due to close proximity of structures or any other reason that the Engineer may consider, will have to be excavated by chiseling.

The Contractor may resort to any of the following methods to excavate rock by chiseling

Wedging by means of chisels, wedges, pneumatic drills and crowbars.
Heating and quenching. Controlled blasting with a small charge just sufficient to make a
crack in rock which will be subsequently removed by wedging.

No claim for extra payment shall be entertained by the Board, for using explosives for excavation in hard rock as mentioned above where excavation by chiselling is specified or directed by the Engineer. Payment shall be made on cubic metre basis.

7.F.3 Dewatering

Contractor shall take into account the subsoil and ground water conditions which may be encountered and shall adequately allow for shoring/strutting and dewatering by pumping.

Drainage channels and sumps shall be provided in the pit to drain all surface and ground water by pumping. Contractor shall dewater and maintain excavated pits dry at all times by use of dewatering sump pumps including ancillary equipment for the construction of substructure of pumping station and reservoir during actual excavation; laying PCC and RCC, inspection, testing and backfilling etc., or as directed by Engineer at the Site where inflow of ground water in the opinion of Engineer obstructs the progress of work, leads to insanitary conditions by stagnation, retards the speed of construction, is detrimental to the safety of workers, materials, structure, equipment and such other causes. The ground water level shall be lowered well below the founding level to provide dry firm working conditions and to prevent sand boiling or bottom heave with consequent loss of bearing capacity. Heavy pumping in excavation which may result in removal of fine material from soil shall be avoided. Contractor shall ensure that there is no damage to existing adjoining structures due to dewatering operations. Contractor shall also make necessary arrangements for the disposal of drained water to nearby storm water drain or nullah/river as approved by Engineer. In no case removal of water shall be allowed to spread over the adjoining area.

Contractor shall exercise his own judgement regarding the extent of pumping required and approximate size of dewatering pumps and other facilities required to keep the excavation dry. Contractor shall submit his scheme and also indicate sequence of operation, limits of excavation and the capacity and other details of the equipment and accessories he intends to use for dewatering during the construction and the number, capacity and location of pumps etc. The Contractor shall bring to site only such equipment and accessories which are approved by Engineer in writing. The Contractor shall provide adequate standby arrangement for pumping in case of electric power failure/mechanical failure.

No separate payment whatsoever shall be made for dewatering if required to be done during excavation, laying PCC and construction of RC substructure up to the plinth level, laying and jointing of pipes, construction of manholes, inspection, testing and backfilling etc., and Contractor should quote accordingly.

7.F.4 Water tightness test - Commissioning of Reservoir.

Post completion of rehabilitation and repair works, the contractor shall carry out the cleaning and disinfection of the tank and should be made ready for use. The GLR shall be commissioned by filling water for the maximum water head condition i.e., with the water standing at FTL of the tank. The water for the same will be provided by BWSSB.

Before the filling operation is started, the reservoir shall be jointly inspected by the Engineer and the Contractor's Representative. The condition of surfaces of wall, contraction and expansion joints shall be noted and it shall be ensured that jointing material filled in the joints is in position and all openings are closed. The Contractor shall make necessary arrangements for ventilation and lighting for the compartment by way of flood lights, circulators, etc., for carrying out proper inspection of the surfaces and inner conditions if so desired by the Engineer. For this purpose, it shall be verified that the butterfly valves and sluice valves provided on the various pipes connected to the reservoir are properly closed. Complete records of such inspections shall be kept. The filling of the compartment then shall be carried out gradually at the rate not exceeding 30 mm rise in water level per hour and shall preferably extend over a period of 72 hours. Records of leakages starting at different level of water in the reservoir, if any, shall be kept.

7.F.5 Backfilling

Backfilling all around the substructure of pumping station and reservoirs shall be done in equal successive layers by watering, ramming and consolidating in layers of 15 cm after obtaining permission from Engineer to backfill. Backfilling around reservoirs shall be done only after successful testing of the reservoirs. Pipeline trenches shall be backfilled with approved selected excavated material only after successful testing of the pipe line. The tamping around the pipe shall be done by hand or other hand operated mechanical means. The water content of the soil shall be as near the

optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both sides of pipe in such a manner that unequal pressure does not occur. Backfilling shall be done in layers not exceeding 30 cm. Each layer shall be consolidated by watering, ramming, care being taken to avoid damage to pipe line.

7.F.6 Clearing of Site at BTR Reservoir

The Contractor shall set out all lines for reservoir, inlet and outlet chambers, office and chlorine rooms, incoming and outlet pipes, roads, drains etc, the existing trees falling under permanent works shall be marked and the Engineer shall be informed. Only those trees which are absolutely necessary shall be cut and stacked inside the plot as directed by the Engineer. Roots or stumps of trees encountered during excavation shall be removed. The Contractor shall obtain necessary permission from appropriate authorities before starting the cutting of trees.

7.F.7 Soil Topping and Turfing

Soil Topping

So far as practicable, material obtained from excavations shall be used as top soil and it shall be separately stored in temporary spoil tips as specified. If, in the Engineer's opinion, the Contractor cannot reasonably obtain sufficient top soil in this way, the Engineer may order the Contractor to provide extra material or all top soil from an approved source off the site.

Top soil shall be evenly spread and trimmed over embankments and on roof slab of reservoir to the slopes and levels shown on the drawings or ordered by the Engineer. The depth, after spreading and trimming, shall be 200 mm, measured perpendicular to the surface of embankments and 300 mm over roof slab. All clods and lumps shall be broken up and any rubbish, large stones, roots and weeds shall be removed prior to spreading.

Turfing

Where directed by the Engineer, areas which have been covered with 200 mm of top soil shall be sown with an approved grass seed suitable for local conditions. The Contractor shall be responsible for maintaining grassed areas in good condition until the end of defects liability period, including all watering, rolling, fertilizing, weeding, cutting and re-sowing as necessary.

Measurement for Top Soil and Turfing

Items for 'spreading top soil' shall include for obtaining top soil from spoil tips on the site, hauling and spreading, all as specified. Top soil brought from outside the site or approved source off the site shall qualify for measurement extra over spreading top soil. Turfing shall include for all work as specified in the above paragraph. Top soil and turfing shall be measured as the surficial areas so treated over roof slab. Items for embankments include top soil and turfing.

7.F.8 Dangers of Floatation

Special attention is drawn to the danger of floatation on the site. Although this cannot occur with any of the finished structures, it may be necessary during construction to flood or otherwise increase the effective weight of structures, if the adjacent ground water level rises sufficiently or risk of sudden flooding so warrants.

7.F.9 Plain and Reinforced Concrete

In general, plain and reinforced concrete work for construction of booster pumping station and balancing reservoirs shall be carried out in accordance with the specifications for concrete and allied works unless otherwise specified in this specification.

The inside and outside faces of walls of substructures shall be cast with shutters lined with plywood and shall be smooth finished as per specifications.

The exposed faces of other RCC members shall be cast with shutters lined with plywood and shall have smooth finish or rough board finish as indicated in drawings. Through bolts or ties for formwork shall not be allowed and the formwork shall be suitably supported by studs, walers, braces, ties, straps, shores etc., to hold the forms in proper position without any distortion whatsoever, until the concrete has set sufficiently to permit removal of forms. The lift for vertical walls shall be about 2 m unless otherwise shown in drawings.

Casting of panels for raft and vertical walls shall be done as per the sequence shown on relevant drawings.

The interval between successive vertical concrete pours in any wall panel shall be minimum 3 days. Casting of adjacent floor/wall panels shall be done after an interval of 7 days. While casting the raft utmost care shall be taken by Contractor to see that the dowels for pump foundations are placed at exact location as shown in the drawings. Also vertical walls shall be cast only after all the pipes/plate inserts

are placed at proper locations as shown in the drawings and as approved by Engineer.

M25 grade of concrete used for construction of substructures of booster pumping station below plinth level and reservoirs shall have minimum cement content of 360 kg/cu.m of concrete. In case as per mix design the cement required is more than 360 kg/cu.m of concrete, Contractor shall have to provide the same at his cost. For construction of superstructure, M20 grade of concrete shall be used as per the mix design.

To avoid surface cracks due to variation in atmospheric temperature and exposure to direct sunlight, exposed faces of reservoir walls and slabs shall be kept wet by frequent spray of water or by saturated coverings to the approval of the Engineer. Contractor should take this aspect into consideration and quote accordingly. No extra claim on this account shall be entertained.

Ends of panels cast first shall be provided with grooved keys and PVC waterstops as shown on detailed construction drawings. Contractor shall ensure thorough vibration of concrete around the waterstops. 225 mm wide water stops shall be provided in raft and walls. Puddle/suction delivery pipes shall be set in concrete structures with the greatest care possible so as to achieve proper alignment and level.

All inserts required to be provided by Contractor shall be fixed by him during casting of structural members. Details and locations of such inserts shall be as per the relevant drawing.

The pockets required for fixing sluice gates, pumps, motors, etc., shall be provided as per detailed drawing.

Bar bending schedule for reinforcement shall be prepared by Contractor and got approved from Engineer-in-Charge before proceeding with the work.

7.F.10 Filling of box out in concrete walls

The concreting around puddle/suction/delivery pipes once set by other Contractor shall be done with utmost care without disturbing the alignment and elevation of these pipes, so that subsequent pipe work, valves, etc., may fit properly in their correct positions and at correct levels. Joints between the pipes and concrete shall be completely water tight. In case, any leakage is observed during

testing, the Contractor shall rectify it at his own cost to the complete satisfaction of the Engineer.

7.F.11 Modified Bituminous Membrane Water Proofing

Modified Bituminous Membrane shall be “SUPER THERMOLAY” 4 mm thick weighing 4 Kg/sqm, manufactured using APP Polymer modified bitumen with a central core of non-woven polyester reinforcement (200 gms/sqm) and with top and bottom layers of thermofusible film (top layer could also be sand finished) made by STP Limited in collaboration with Bitumat Company Limited. “PLYFLEX” of Bitumat Company Limited, Saudi Arabia supplied by STP Limited shall also be acceptable or other equivalent specification.

The work shall include waterproofing for the reservoir roof slabs and any other areas as directed by the Engineer. The waterproofing treatment shall be applied as follows :

(a) The top surface of slab shall be cleaned off dirt by air blower

(b) A layer of cold applied bituminous primer at 0.20 kg/sqm shall be applied

(c) A coat of blown bitumen 85/125 shall be applied at the rate of 1.45 kg/sqm

(d) A roll of modified bituminous membrane shall be unrolled over the primed surface and completely bonded to the substrate by pressing down evenly for the full width of the roll using a wooden roller. Torching shall be done where recommended by the manufacturer and where directed by the Engineer as the unrolling progresses.

The side overlaps shall be 100 mm whereas end overlaps shall be minimum 150 mm; both shall be bonded and sealed by flame torching. Care shall be taken that membrane is lapped with treatment along the vertical surface and roof gutter treatment for at least 500 mm. The membrane shall be properly overlapped / terminated at all openings, rainwater downtakes etc., to ensure that such junctions do not become source of leakage.

(e) A layer of 40 mm thick M15 grade screed with 10 mm downgraded aggregate shall be provided over membrane and finished smooth with wooden float.

This work shall be carried out by an experienced specialist Contractor who shall be appointed only after prior approval of the Engineer.

7.F.12 Waterproofing of Roofs/Terraces etc.

7.F.12.1 Water proofing of Horizontal Surfaces

The waterproofing shall be applied as follows :

A coat of Blown Bitumen 85/25 shall be applied at the rate of 1.45 kg/sq.km

A roll of Modified Bituminous Membrane shall be unrolled over the primed surface and completely bonded to the substrate by pressing down evenly for the full width of the roll using a wooden roller. Torching shall be done, where recommended by the manufacturer and where directed by the Engineer-in-Charge, as the unrolling progresses.

The side overlaps shall be minimum 100 mm whereas the end overlaps shall be minimum 150 mm; both shall be bonded and sealed by flame torching.

Care shall be taken that the membrane is lapped with the treatment along the vertical surface and roof gutter treatment for at least 500 mm.

The membrane shall be properly overlapped/terminated at all openings, rainwater downtakes etc. to ensure that such junctions do not become sources of leakage.

Top of membrane finally shall be painted with antiglouse reflective paint.

7.F.12.2 Waterproofing of Vertical Surfaces at Roof Level and Gutters

The Water proofing shall be applied as described in (a) above.

Modified Bituminous membrane shall be unrolled and bonded to the substrate after applying a coat of bitumen and by pressing down evenly for the full width of the roll. Light torching shall be done to ensure complete bonding.

The membrane shall be overlapped with treatment for the horizontal surface by at least 500 mm.

The membrane shall be taken upto a pre-cut chase anchored and sealed.

7.F.13 Cleaning of Reservoirs and Water Retaining Structures

The floor and walls of every reservoir and water retaining structure including sumps, chambers etc., shall be cleaned by removing all dirt, silt, mud, moss, debris, materials etc., and the whole of the interior shall be thoroughly washed and brushed until the water draining away is clean.

On completion of the Works and immediately prior to the use of the Works by the Board, the Contractor shall drain and clean all sumps, chambers etc., again and sterilise them with bleaching powder as directed by the Engineer. No separate payment shall be made on this account. Sterilisation shall be carried out by either of the following methods.

(i) A solution containing 50 mg/l of chlorine shall be prepared and brushed vigorously into the internal surfaces of the structure, left for a contact period of one hour and then flushed with clean water.
(ii) The structures shall be filled to overflow pipe level or top water level with chlorinated water having a free chlorine content of 20 mg/l and left to stand for 24 hours. Above this level all internal exposed surfaces shall be treated as in (i) above.

The Contractor shall provide his employees with gas masks, goggles and protective clothing for carrying out this work.

The Contractor shall be responsible for disposing of the waste chlorine solutions in a manner as to avoid injury or damage to persons, animals, works and materials.

After completion of sterilisation neither the Contractor nor his employees shall enter or interfere with the structures or pipework in any way, except with the written authority of the Engineer and only then on such conditions as the Engineer may impose.

If, after sterilisation has been carried out, any fault in the reservoir or other part of the work develops so that the reservoir or pipework has to be emptied, the Contractor shall empty the structure, carry out the repair and any watertightness testing required, and shall then repeat the sterilisation procedure described above.

7.F.14 Inlet and Outlet Chambers

The inlet and outlet chambers of the reservoirs include sluice gate(s). Sluice gates shall be supplied and erected as per specifications. All the pipes at the inlet and outlet chamber are to be placed in position

at appropriate levels and aligned. Joints between pipes and walls shall be water tight without any sweating. Necessary pockets/ plate inserts etc., shall be provided at required locations by Contractor as per the detail drawing and as directed by Engineer. Box out concreting around thimble shall be done as specified elsewhere.

7.F.15 Civil Structures – General

Contractor shall cooperate with all the agencies working in or near the reservoir and pumping station. Any damage caused by the Contractor to the structure, sanitary fixtures, electrical and mechanical equipment etc., shall be made good and restored to its original condition/or replaced at no extra cost to Employer/Engineer. Final coat of painting shall be done after all the mechanical and electrical equipments are tested and commissioned.

Contractor shall rectify all defects in civil works during the defects liability period.

End of Part 7F

SPECIFICATIONS FOR VALVES

7.G. 1 GENERAL

1.1 Valves shall be as per internationally recognized standards. Flanges shall be machined faces and edges to ISO 7005, IS 6392 or BS 4504. All valves shall be PN 16 rating with PN 16 flanges.

1.2. Valves shall be double flanged type and the face shall be parallel to each other and flange face should be at right angles to the valve centerline. Back side of valve flanges shall be machined or spot faced for proper seating of the bolt head and nut.

1.3. Valves buried or installed in underground chamber, where access to a hand wheel would be impractical, shall be operated by means of extension spindle and /or keys.

1.4. Valves of diameter 350 mm and above shall be provided with lifting eyes and shall have detachable bolted covers for inspection, cleaning and servicing.

1.5. Valves shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.

1.6. The valve stem, thrust washers, screws, nuts and all other components exposed to water shall be of a corrosion resistant grade of stainless steel SS 316.

1.7. All valves shall be housed in chambers as per drawings.

1.8 All the valves should be with Electro static powder coating both inside and outside with pocket less body passage of minimum 250 microns DFT (Dry Film Thickness).

7.G.2 SLUICE VALVES:

(a) All the Sluice valve shall be of resilient seated, glandless design generally confirm to BS 5163 -89/ IS 14846 -2000 / DIN 3202 F4/ F5.

(b) Sluice valves shall be of non-rising spindle type.

(c) Valves of 400mm and above shall be provided with thrust bearing arrangement for ease of operation.

(d) Valves of diameter 400 mm and above shall be provided with enclosed gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified rating. Valve and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 400 N.

(e) All valves, spindles and hand wheels shall be positioned to give good access for operational personnel.

(f) All the hand wheels shall be arranged to turn in a clockwise direction to close the valve. The direction of rotation for opening and closing of the valve shall be indicated on the hand wheels.

(g) The material of construction of valve shall be as follows :

S. No.	**Component**	**Material**
(i)	Body & Bonnet	SG Iron IS 1865 Gr. 500/7 or Gr. GGG50
(ii)	Doors/Wedge	SG Iron IS 1865 Gr. 500/7 or Gr. GGG50 Rubber lined with EPDM Food Grade quality
(iii)	Spindle	Stainless Steel: BS:970 Gr 431 /420
(iv)	Thrust collar & Wedge Nut	Bronze : IS:318 Gr LTB2

S. No.	**Component**	**Material**
(v)	Internal & External Fasteners	Stainless steel AISI 316
(vi)	Seals	Food Grade EPDM
(vii)	O-Rings	NBR

All Sluice valves shall be open end tested. Sluice valves above 300mm shall be provided with bypass arrangement in conformity with clause 7 of IS 14846.

Nominal size of Sluice Valve (mm)	*Size of By Pass Arrangement* (mm)
250	25
300	25
350	40
400	40
450	50
500	50
600	65
700	80
750	80
800	80
900	100
1000	100
1100	125
1200	125

7.G.2.1 Dimensions:

The dimensions of valves, bolts and nuts, hand wheels shall conform to the values given in Table 4, and clause 7.7 of Is 14846 respectively. Size of valves and pressure rating as per Bill of quantities. Location of valves shall be as per contract drawings or as specified by the Engineer in charge.

End of Part 7G

SECTION 8:

DRAWINGS

SECTION 9:

BILL OF QUANTITIES

Note:

(1) Item for which no rate or price has been entered in will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities (refer: ITB Clause 11.2 and CC Clause 37.2).

(2) Unit rates and prices shall be quoted by the Tenderer in Indian Rupees.

(3) Where there is a discrepancy between the rate in figures and words, the lower of the two will govern. [ITT Clause 24.1(a)]

(4) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by quantity, the unit rate quoted shall govern [ITT Clause 24.1 (b)]

SECTION 10:

FORMAT OF BANK GUARANTEE FOR SECURITY DEPOSIT

To: _____ [name of Employer]
_____ [address of Employer]
WHEREAS _____ [name and address of Contractor] (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute _____ [name of Contract and brief description of Works] (hereinafter called "the Contract");
AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;
AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;
NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of Rs._____ [amount of guarantee] [63]_Rupees_____ _____[in words], and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____ [amount of guarantee][64] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.
We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.
We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.
This guarantee shall be valid until 30 days from the date of expiry of the Defects Liability Period.
Signature and seal of the guarantor _____
Name of Bank _____
Address _____
Date _____

[63] An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract

[64] An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract